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REPORT OF THE COMMISSIONER

TO THE

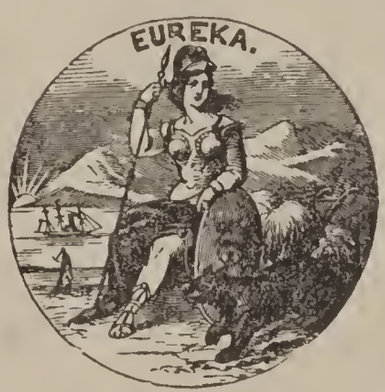
PARIS EXPOSITION,

1867.

NOTES UPON THE UNIVERSAL EXPOSITION AT PARIS, 1867,

BY WILLIAM P. BLAKE,

COMMISSIONER FOR THE STATE OF CALIFORNIA TO THE UNIVERSAL EXPOSITION AT PARIS, 1867, AND DELEGATE OF THE STATE BOARD OF AGRICULTURE.



SACRAMENTO:

D. W. GELWICKS, STATE PRINTER,

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LETTER TRANSMITTING THE REPORT.

Hon. H. H. Haight,
Governor of the State of California:

Sir: I have the honor to submit the following report upon the Paris Universal Exposition of eighteen hundred and sixty-seven. It consists of brief notices of some of the objects and industries which appeared to be of special importance or interest to California, and it is based partly upon a series of letters which, during the progress of the Exposition, I addressed to the Mining and Scientific Press, of San Francisco, and which were published. These letters have been revised and greatly augmented.

The variety of productions of California displayed at Paris was secured, in great part, by the joint exertions of the State Agricultural Society and a Committee of the Chamber of Commerce, including citizens of San Francisco. The influence and aid of the daily press of San Francisco was also freely given, and the Pacific Mail Steamship Company and the Panama Railroad Company transported all the articles over their lines without charge.

Owing to the absence of any appropriation by the State to pay the expenses of the representation at Paris, my arrival there was delayed until June. At that time most of the objects sent from California had arrived safely, and through the attention and care of Mr. Edgar Mills, of Sacramento, Delegate of the State Board of Agriculture, had already been placed in the Exhibition.

The sum of one thousand dollars, raised by subscription among the citizens of San Francisco, was forwarded to me, and had been applied towards the incidental expenses of the representation.

Very respectfully, your obedient servant,

WILLIAM P. BLAKE,

Commissioner for the State of California to the Universal Exposition at Paris, eighteen hundred and sixty-seven, and Delegate of the State Board of Agriculture.

REPORT

UPON THE

UNIVERSAL EXPOSITION AT PARIS, 1867.

CHAPTER I.

GENERAL VIEW OF THE PARIS EXPOSITION OF 1867.

THE BUILDING.

The general plan and arrangement of the Universal Exposition of eighteen hundred and sixty-seven was the result of the observation and experiences of the former great International Exhibitions at London in eighteen hundred and fifty-one, at Paris in eighteen hundred and fifty-five and at London in eighteen hundred and sixty-two. In those Exhibitions grand architectural effects were attempted, and large sums were expended in exterior and interior decoration. In the Exhibition building of eighteen hundred and sixty-seven all architectural display was subordinated to the convenience of grouping and display of the various objects contributed. The leading feature of the plan was the division of the space into seven concentric galleries, each one devoted to a particular group or class of objects.

The form of the building was generally considered to be nearly elliptical, but it was in fact a parallelogram, with rounded ends. Its greatest length was four hundred and eighty-two metres (five hundred and twenty-seven yards), its breadth, three hundred and seven metres (four hundred and six yards). The outer gallery was twelve hundred metres, or three fourths of a mile in length. A central space was reserved for a garden, with fountains and statuary. The whole building was bisected in its

length by a main avenue, crossed at right angles by three others, which, together with avenues or passages radiating from the central space, gave convenient passage from one gallery or group to another. The whole space, thus divided, measured one hundred and forty-six thousand square metres, or thirty-six acres. The superficial area of the building, with the park, was nearly one hundred acres. The total superficial area of the building of the Great Exhibition at London in eighteen hundred and fifty-one was about twenty acres; of the Palace and its dependencies at Paris in eighteen hundred and fifty-five, about thirty-seven acres; and of the International Exhibition of eighteen hundred and sixty-two at London, about twenty-four acres.

Of the total space one hundred and fifty-one thousand seven hundred and fifty and forty-six hundredths square metres in the building of eighteen hundred and sixty-seven, according to the official table, France occupied sixty-three thousand six hundred and forty and eighty-eight one-hundredths; Great Britain, twenty-one thousand and fifty-nine and eighty-seven one-hundredths; Prussia, twelve thousand seven hundred and sixty-five and twenty-seven one-hundredths; Austria, eight thousand three hundred and sixty-two and fifty-eight one-hundredths; Belgium, six thousand nine hundred and ninety-three and ten one-hundredths; Russia, six thousand and sixty and seventy one-hundredths; the United States, three thousand nine hundred and forty-four and seventy-four one-hundredths square metres.

In the Exhibition of eighteen hundred and fifty-one the total number of exhibitors was between fifteen thousand and sixteen thousand; in eighteen hundred and fifty-five, twenty-three thousand nine hundred and fifty-four; in eighteen hundred and sixty-two, twenty-eight thousand six hundred and fifty-three; and in the Exhibition of eighteen hundred and sixty-seven, the number reached sixty thousand. Of this number France had eleven thousand six hundred and forty-five exhibitors; England, twenty-one thousand; and the United States, seven hundred and seventy-eight.

The weight of the different objects exhibited was not less than twenty-eight thousand tons. The communication established by rail between the Palace and the railroads of the continent furnished the means of conducting and installing with the necessary care and celerity this enormous mass of material, which, for the most part, arrived at the end of the month of March.

The iron pillars and girders used in the construction of the building weighed thirteen thousand five hundred tons; the windows and skylights required sixty-five thousand square metres of glass; the masonry fifty-two thousand cubic metres of stone and brick, and the woodwork fifty-three thousand square metres of plank. The length of the sewers was five miles. The steam for the engines was generated outside of the building, and was conveyed by pipes under the surface of the ground a distance of one hundred feet.

The motive power required to put the various machines exhibited in motion was more than that of one thousand horses.

The machine gallery was divided into fifteen portions, corresponding with the requirements of the various nations, as follows: France, eight portions, with a total force of three hundred and five horse power; Belgium, one portion, forty horse power; North German Confederation, one portion, thirty-five horse power; Southern Germany, one portion, fifteen horse power; Austria, one portion, twenty horse power; United States, one portion, fifty horse power; Great Britain, one portion, one

hundred horse power. The mode of transmission of the power was by shafts overhead, supported on columns entirely disconnected with the frame of the gallery of the building, in order to avoid any unpleasant jar or vibration. There were two parallel main shafts, with an average diameter of nine one-hundredths of a metre and a velocity of one hundred revolutions a minute. They were so arranged as to form a polygon, of which the sides had an average length of about fourteen metres. These sides formed angles of about five degrees, and the connections were made either by a Cardan joint, by toothed gear or other method adopted by the exhibitor.

The supply of water for the building and Park was equal to that required for a city of one hundred thousand inhabitants, and it was provided by the Exhibition and not obtained from the city. A high and low service was organized, as a great part of the consumption, such as the cascades in the Park, did not require high pressure. The high service included a reservoir of four thousand metres capacity, established at the summit of the Trocadero, at the height of thirty-two metres (about one hundred feet) above the level of the Exhibition building, and a hydraulic establishment by the side of the Seine, just below the Bridge of Jena. The low service was fed by the pumps of the great marine engine of Indret, of one thousand horse power, placed by the river above the bridge. These pumps were capable of lifting twelve hundred cubic metres of water an hour. The high service supplied the irrigation of the Park, the fountains, the hydrants, etc., and the low service the condensers, the boilers, the cascades and the canals.

Arrangements were also made for a large supply of air to aid the natural ventilation. This was forced into the building by separate engines and large pump blowers, requiring in the aggregate one hundred horse power. This air, which it was estimated had a volume of seven hundred thousand metres per hour, was delivered through sixteen radial passages, corresponding with those in the building.

In the construction of this building upwards of three hundred and seventy thousand cubic metres of soil had to be removed for foundations, drains and water pipes, and air passages. The outer circle was excavated so as to give a succession of vaulted cellars, built of stone and concrete and lined with cement. The two interior galleries of the superstructure were built of stone, and the seven others were of iron. The outer gallery, devoted to engines and machinery, was the highest and broadest of all, and its roof was sustained by one hundred and seventy-six iron pillars, which supported eighty-eight arched ribs of iron. The covering of the roof was made of corrugated iron plates.

It will be noted that the form and arrangement of the galleries of the building corresponded with the classification or grouping of objects adopted by the Imperial Commission, which was briefly as follows:

LIST OF GROUPS, WITH THE CLASSES ATTACHED.

Groups.	Class.
GROUP I.—WORKS OF ART.	
Paintings in oil	1
Other paintings and drawings	2
Sculpture and dye-sinking	3
Architectural designs and models	4
Engraving and lithography	5
GROUP II.—APPARATUS AND APPLICATION OF THE LIBERAL ARTS.	
Printing and books	6
Paper, stationery, binding, painting and drawing materials	7
Applications of drawing and modelling to the common arts	8
Photographic proofs and apparatus	9
Musical instruments	10
Medical and surgical instruments and apparatus	11
Mathematical instruments and apparatus for teaching science	12
Maps and geographical and cosmographical apparatus	13
GROUP III.—FURNITURE AND OTHER OBJECTS FOR THE USE OF DWELLINGS.	
Fancy furniture	14
Upholstery and decorative work	15
Crystal fancy glass and stained glass	16
Porcelain, earthen ware and other fancy pottery	17
Carpets, tapestry and other stuffs for furniture	18
Paper hangings	19
Cutlery	20
Gold and silver plate	21
Bronzes and other art castings and repoussé work	22
Clocks and watches	23
Apparatus and processes for heating and lighting	24
Perfumery	25
Leather work, fancy articles and basket work	26
GROUP IV.—CLOTHING (INCLUDING FABRICS) AND OTHER OBJECTS WORN ON THE PERSON.	
Cotton thread and fabrics	27
Thread and fabrics of flax	28
Combed wool and worsted fabrics	29
Carded wool and woollen fabrics	30
Silk and silk manufactures	31
Shawls	32
Lace, net, embroidery and small ware manufactures	33
Hosiery and underclothing and articles appertaining thereto	34
Clothing for both sexes	35

Groups.	Class.
Jewellery and precious stones	36
Portable weapons	37
Travelling articles and camp equipage	38
Toys	39
GROUP V.—PRODUCTS, RAW AND MANUFACTURED, OF MINING INDUSTRY, FORESTRY, ETC.	
Mining and metallurgy	40
Forest products and industries	41
Products of the chase and fisheries; uncultivated products	42
Agricultural products (not used as food)	43
Chemical and pharmaceutical products	44
Specimens of the chemical processes used in bleaching, dyeing, printing, etc	45
Leather and skins	46
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Apparatus used in shooting, fishing tackle and implements used in gathering fruits obtained without culture	49
Apparatus and processes used in agricultural works and in works for the preparation of food	50
Apparatus used in chemistry, pharmacy and in tan yards	51
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Machines and apparatus in general	53
Machine tools	54
Apparatus and processes used in spinning and ropemaking	55
Apparatus and processes used in weaving	56
Apparatus and processes for sewing and for making up clothing	57
Apparatus and processes used in the manufacture of furniture and objects for dwellings	58
Apparatus and processes used in paper making, dyeing and printing	59
Machines, instruments and processes used in various works	60
Carriages and wheelwrights' work	61
Harness and saddlery	62
Railway apparatus	63
Telegraphic apparatus and processes	64
Civil engineering, public works and architecture	65
Navigation and lifeboats	66
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Cereals and other eatable farinaceous products and the products derived from them	67

Groups.	Class.
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Fatty substances used as food, milk and eggs	69
Meat and fish	70
Vegetables and fruit	71
Condiments and stimulants, sugar and confectionery	72
Fermented drinks	73
GROUP VIII.—LIVE STOCK AND SPECIMENS OF AGRICULTURAL BUILDINGS.	
Farm buildings and agricultural works	74
Horses, asses, mules	75
Bulls, buffaloes, etc	76
Sheep, goats	77
Pigs, rabbits	78
Poultry	79
Sporting dogs and watch dogs	80
Useful insects	81
Fish, crustacæ and mollusca	82
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Hothouses and horticultural apparatus	83
Flowers and ornamental plants	84
Vegetables	85
Fruit trees	86
Seeds and saplings of forest trees	87
Hothouse plants	88
GROUP X.—ARTICLES EXHIBITED WITH THE SPECIAL OBJECT OF IMPROVING THE PHYSICAL AND MORAL CONDITION OF THE PEOPLE.	
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Libraries and apparatus used in the instruction of adults at home, in the workshop or in schools and colleges	90
Furniture, clothing and food from all sources, remarkable for useful qualities combined with cheapness	91
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Examples of dwellings characterized by cheapness combined with the conditions necessary for health and comfort	93
Articles of all kinds manufactured by skilled workmen	94
Instruments and modes of work peculiar to skilled workmen	95

To each of the first seven of these groups a circle or gallery of the building was arranged thus: Group I—Works of Art—occupied the inner circle or gallery; Group VI—the engines, machines, etc.—were placed in the outer gallery, a portion of which, along the outer side, was devoted to Group VII; and here, for example, were arranged the cereals,

the seeds, dried fruits, wines and liquors. Group V—Raw and manufactured productions, such as minerals, ores, forest products, etc.—were placed in the gallery adjoining that containing the machinery. By following these galleries the visitor passed in succession among the productions similar in kind of different countries, while by following the avenues the visitor saw in succession the various productions and manufactures of the same country.

After the adoption of this system it was decided to devote a portion of the inner circle to antiquities, so arranged as to give an approximate history of the progress of the arts from the earliest periods to the present time. This became a very interesting part of the Exposition to all classes of visitors. Even the pre-historic period was represented by collections of flint and bone implements from the caves and from the lake dwellings of Switzerland. The bronze period was also illustrated, and so on through the great periods of human history to the present age of steel.

The nature of the articles shown in this gallery of the "History of Human Labor" appears more fully by the following enumeration in the classification, by periods, adopted by the Imperial Commission:

First Epoch—Gaul before the use of metal. Utensils in bone and stone, with the bones of animals that have now disappeared from the soil of France, but found with these utensils, and showing the age to which they belong.

Second Epoch—Independent Gaul. Arms and utensils in bronze and stone. Objects in terra cotta.

Third Epoch—Gaul during the Roman rule. Bronzes, arms, Gaulish coins, jewellery, figures in clay; red and black potteries, incrusted enamels, etc.

Fourth Epoch—The Franks to the crowning of Charlemagne (A. D. eight hundred). Bronzes, coins, jewels, arms, pottery, MS. charters, etc.

Fifth Epoch—The Carlovingians, from the commencement of the ninth to the end of the eleventh centuries. Ivory sculptures, bronzes, coins, seals, jewels, arms, MS. charters, etc.

Sixth Epoch—The middle ages, from the commencement of the twelfth century to Louis XI (inclusive), fourteen hundred and eighty-three. Sculpture (statuary and ornamental), ivory, wood, furniture, bronzes, coin, seals, jewels, arms and armor, MS., miniatures, enamels, pottery, stained glass, tapestry, embroidery, dresses, etc.

Seventh Epoch—The Renaissance, from Charles VIII to Henry IV (A. D. sixteen hundred and ten). Sculpture (statuary and ornamental), ivory, sculptured wood, bronzes, coins, medallions, seals, jewels, arms, cutlery, watch-making, miniatures, MS., painted enamels, varnished pottery, pottery called Henry II and Bernard Palissy, glass work, stained glass, tapestry, embroidery, bindings, etc.

Eighth Epoch—Reigns of Louis XIII and XIV (A. D. sixteen hundred and ten to seventeen hundred and fifteen). Sculptures, ivories, furniture, bronzes, coins, medallions, seals, jewels, arms, watches, miniatures, MS., enamels, pottery of Nevers and Rouen, porcelain of Rouen and St. Cloud, marqueterie tapestry, embroidery, etc.

Ninth Epoch—Reign of Louis XV (A. D. seventeen hundred and fifteen to seventeen hundred and seventy-four).

Tenth Epoch—Reign of Louis XVI and the Revolution (A. D. seventeen hundred and seventy-four to eighteen hundred).

THE PARK.

The visitor to the Exhibition was at once forcibly impressed with the importance and extreme interest of the Park as part of the Exhibition. It was most tastefully laid out with avenues and winding paths, and was adorned with trees, shrubs and flowers, all planted since the ground was first broken for the foundation of the Palace, on what was previously the barren and indurated surface of the *Champs de Mars*. A few short months sufficed to make a total change. Water was brought in, artificial lakes, canals and streams were made; grottos were built and gardens were planted with flowers; constructions of all kinds arose as if by magic, and at the opening of the Exhibition examples were seen of the peculiar architecture of almost all the nations of the earth, from the tent of the wandering Arab to the gilded palace of Europe. In the vicinity of the Yankee school-house one could see a palace of the Bey of Tunis, an Egyptian temple, the catacombs of Rome, the temple of Xochicalco, Mexico, with full sized models of its ancient altars, a Protestant church and a Turkish harem. A small American farm-house was also erected and was visited by thousands of persons.

The main entrance to the Exhibition was at the end turned towards the Seine, opposite the Bridge of Jéna. A grand avenue about forty feet wide led directly through the Park to the building. This was the official avenue, and it was bordered by tall ornamental columns, which sustained a canopy of green velvet, studded with gold stars. At the gate you passed between two monumental bronze fountains about forty feet high and with basins fifty feet in diameter. That upon the right was of cast iron, from the celebrated foundries of Durenne, at Sommevoire, which contributed many other objects of interests to the interior of the building. A little beyond, six tall columns of polished marble, of different colors, ornamented the border of a path leading to a Gothic church on the left, which commanded attention by the beauty of its form and finish and its evident solidity and apparent permanence, although only a temporary edifice. Its roof afforded an opportunity for the display of tiles of various patterns and colors, and its windows for the exhibition of stained glass work, by different artists. Near the church rose an iron light-house from the water of an artificial lake. Two buildings of iron and glass, one on each side of the entrance and next beyond the large fountains, were devoted to exhibitions of iron and steel. One contained huge ingots of cast steel, three feet square and broken across, so as to show the nature of the grain. Here, too, were enormous girders, in one piece; railroad rails as straight almost as the bed of a planing machine, and again twisted into spirals and tied into knots, so as to display to advantage their extraordinary strength and toughness. Beyond, but yet at the side of the grand avenue, a building was devoted to the display of English ordnance and munitions of war, from a rifle to the celebrated Whitworth and Armstrong guns of different sizes, with the shot and shell peculiar to each.

Alongside of this building there was a pleasing vista over green lawns and parterres of flowers to the American *annexe* beyond, where could be seen the beautiful locomotive and various agricultural machines. On the left of the avenue was a building for the display of windows of stained and painted glass, to which the art of photography had lent its aid. Portraits and photographs were there reproduced in all the brilliance and permanence of color of stained glass.

In continuing a walk toward the entrance of the building, the visitor

reached a model English cottage of striking beauty, adorned with several varieties of exterior finish in incised plaster, in parti-colored brick, in beton, slate, and in tiles of different patterns. In the interior the different manufacturers of glazed and encaustic tiles vied with each other in producing the most pleasing patterns upon the floors and walls. The different forms of ranges and stoves were displayed in almost endless variety. A few steps beyond took the visitor to the Imperial Pavilion, in Moorish style, and superbly furnished with the choicest productions of France. The marble steps were inlaid with fine mosaics, and were guarded by two Imperial eagles in bronze, standing upon gilt spheres. The building contained three apartments, and was occupied by the Emperor when visiting the Exhibition.

These details upon some of the structures met in passing through the Park will serve to show the general character of the other portions, crowded, as they were, with buildings of the greatest interest in themselves, and for their contents. Many of them contained collections which were complete exhibitions in themselves. Spain, for example, filled a large building with a representation of its mineral and agricultural productions. Russia had several buildings—one, a model farm-house, was devoted to the products of its fisheries, to its furs, costumes of its interior tribes, and to its agricultural machines and products. A large stable contained the different breeds of horses, represented by choice individuals. The Russian Commissioners had an office in a model Russian cottage. In the part of the Park given to Holland, a brick building, standing by itself among the shrubs and trees, was a complete diamond-cutting establishment, where several workmen were constantly engaged in cutting and polishing diamonds—an art that is seldom exhibited to the public.

THE RESERVED GARDEN.

A portion of the Park was separated from the rest of the Exhibition by a long line of ornamental iron railings, and devoted to trees, shrubs and flowers from all climes. An enormous structure of glass and iron crowning an eminence above a lake afforded a tropical atmosphere for a large display of palms, ferns and bananas. Some of these plants were at least twenty feet high, as for example the *Phœnix dactilifera;* and there were tree ferns eight feet high, besides numerous species of palms growing together, so as to make a complete forest In other portions of the garden there were large conservatories and aquariums devoted to the yuccas and agaves, to the cactacea and to the aquatic plants—such as the water lilies, including the celebrated Victoria regia. The borders and terraces of the grounds were planted with a great variety of shrubs and evergreen plants, amongst which the plants of Japan and California were conspicuous—such, for example, as the *thujas*, the *euonymus*, the *librocedus* and the *sequoia gigantea*, mingled with the hollys and yews of Great Britain.

The management of lawns, gravel-walks, borders and parterres of flowers was well shown by the exquisitely kept plats of grass and borders between the winding paths and along the artificial stream. The competitive exhibitions of flowers were made there according to the season, and thus insured a constant but ever varying brilliant display. The grottos and the fish aquariums gave an additional attraction to the place, and it was a delightful resort after the fatigue of a day in the building.

BILLANCOURT.

The horticultural and agricultural display at the Champ de Mars was supplemented by one at the Island of Billancourt, in the Seine, about three miles below the Exposition building. The objects and processes shown there were such as could not be conveniently exhibited in the building or in the Park—such as many of the agricultural machines, the various domestic animals, and the operations of ploughing, sowing, reaping, threshing, etc. The superficial area of this island is about twenty-three hectares (about fifty-seven acres) and the soil, being formed of the alluvions of the river, is quite deep and fertile.

The competition of agricultural machines was announced to occur in the following order:

April.—First fortnight—Ploughs of all sorts, hydraulic machines, steam machines.

Second fortnight—Steam ploughs, harrows, rollers, weeding machines, scarifiers, apparatus for the manufacture of drainage pipes and the preparation of clay.

May.—First fortnight—Sowing and manuring machines, machines for stripping hemp and flax, vehicles, harness, weights, churns and dairy utensils.

Second fortnight—Mowing and haymaking machines, rakes, apparatus for the compression and preservation of hay.

June.—First fortnight—Competition of farriery, and examination of specimens of rural establishments.

Second fortnight—Hay cutter, root cutter, hoes, ploughs.

July.—First fortnight—Apparatus for shearing various domestic animals.

Second fortnight—Reaping machines and apparatus for the corn harvest.

August.—First fortnight—Threshing machines, and apparatus for cleaning and preserving corn.

Second fortnight—Ovens, apparatus for cooking vegetables, washing linen, manufacture of manure.

September and October.—Examination of specimens. Various agricultural manufactures.

STATISTICAL INFORMATION.

The idea of an Exposition, as well as an Exhibition, was in a great measure realized. The arrangement and grouping was such as to invite and stimulate comparison, as well as to afford the greatest convenience for the study of different departments. Nearly all the different countries represented published descriptive catalogues, with interesting statistics and information appended to them. The most extensive and elaborate work of this kind was published by the Russian Commission, in two handsome octavo volumes, one of them a statistical view of the productive forces of Russia, and the other a descriptive catalogue of the objects exhibited. Works of this character were published by Prussia, Belgium, Austria, Sardinia, Brazil and Chile, besides smaller pamphlets and circulars by the Central American republics, Australia and the Hawaiian Islands. Mr J. P. Whitney, the Commissioner from Colorado, published a notice of the Territory and its minerals in several languages, and distributed them freely; and Colonel D. Buel, of Austin, published

a little volume in English and French descriptive of the various mining districts of the eastern part of Nevada, accompanied by a map. All of these documents giving statistics of the resources and productions of the Pacific States were eagerly sought for, and many applications were made for statistics of the State of California.

DISTRIBUTION OF PRIZES.

The work of the juries commenced as soon as the Exhibition opened, and the awards were made very soon thereafter, and in many cases before some of the contributions were fairly placed and labelled. The grand ceremony of the distribution of prizes was on the first of July, at the Palace of Industry, the building erected for the Exhibition of eighteen hundred and fifty-five. The recipients of grand prizes and gold medals reeeived them from the hands of the Emperor, in the presence of seventeen thousand spectators, all comfortably seated in that magnificent hall.

A report was presented at this time by M. Rouher, Minister of State and Vice President of the Imperial Commission, enumerating in a general way the prineipal operations of the Commission and of the Jury, stating the total number of awards and citing some of the great international advantages derived from the Exposition.

The International Jury was composed of six hundred members, chosen from men distinguished in science, industry, commerce and art, and of various nationalities. This Jury awarded:

Grand prizes	64
Gold medals	883
Silver medals	3,653
Bronze medals	6,565
Honorable mentions	5,801

The Jury of the new order of prizes awarded twelve prizes and twenty-four honorable mentions. In addition, the Emperor was pleased to confer upon some of the most eminent of the competitors in the Exhibition the Imperial Order of the Legion of Honor.

The prizes awarded to exhibitors from California were as follows:

State of California*—Cereals. Silver medal.

Dr. J. B. Pigné, San Francisco—Collection of California minerals. Silver medal.

William P. Blake, California—Collection of California minerals. Silver medal.

* The official announcement of this award reads: "*Le Gouvernement de Californie.—Céréals.*" As the State of California was not an exhibitor, this destination of the award is apparently the result of misapprehension. The exhibitors of cereals were Mr. D. L. Perkins, Mr. J. W. H. Campbell and Mr. J. D. Peters. The display made by Mr. Perkins included one hundred and twenty varieties of seeds, neatly arranged in glass bottles and labelled, and, together with the photograph, was the most prominent. It is the opinion of the Commissioner that the medal should either be given to Mr. Perkins or to the exhibitors of cereals jointly.

Mission Woollen Mills, San Francisco—Exhibition of blankets, cloths and flannels. Bronze medal.

C. E. Watkins, San Francisco—Photographs of Yosemite Valley. Bronze medal.

Brown & Level, California—Self-detaching boat tackle. Bronze medal.

Buenavista Vinicultural Society—Sparkling wine. Honorable mention.

CHAPTER II.

WOODS AND PRODUCTS OF THE FOREST.

FRANCE.

The forest products and industries of nearly every country were represented in the Exposition, by sections of trees, planks, boards, mouldings, etc., and by collections of the tools used for cutting, hewing and sawing.

Of all these collections, that made by France, through the "Administrator of the Forests," was the most complete, methodical and interesting. It occupied a space about sixty feet in length, in the second gallery, devoted to Group V, and was very tastefully displayed. Sections of all the principal kinds of trees in the Empire were ranged along the wall with the interspaces filled with green moss. Each section of a tree was about six inches thick, and included the bark, so that the whole structure and outer form and appearance of the trunk was clearly shown. Above these, on a table which extended around the room, smaller sections and portions of dressed and worked timber were arranged, with herbaria, photographs and drawings of forest trees. The tools used were grouped above, on the wall, around centre pieces, formed of boar's heads. In the centre of the room a broad table sustained various models of forests and of sawmills, and of apparatus used in felling and transporting timber. There were also models of the buildings erected for the keepers' lodges, and of cottages for the laborers. Some of the plans in the relief exhibited the important operations of the administration of forests, such as the replanting of the Alps. A large forest chart upon the wall, of France, showed in the most striking manner the distribution of the wooded parts of the country and the relation which exists between them and the geological constitution of the soil. The whole collection was completed by a series of specimens of the various destructive forest insects.

There was also a series of publications on practical or scientific questions, relating to sylviculture, and a fine collection of photographs of cones and foliage of the various pines and firs.

The woodlands of the Empire of France amount to eight million nine hundred thousand hectares (a hectare is equal to two acres, one rood and thirty-five perches), divided as follows:

First—One million one hundred thousand hectares belonging to the State, of which forty-nine per cent. is in timber (five hundred and thirty-nine thousand hectares), and fifty-one per cent. in coppice, with or without timber.

Second—Two million hectares belonging to communes or public establishments, of which thirty-six per cent. is covered with timber, and sixty-four per cent. with coppice.

Third—Five million eight hundred thousand hectares of private woodlands, seventeen per cent. of which is timbered, and the remainder in coppice, with or without timber.

The annual products of these forests are in the following proportions: Three for the State lands, two and seventy-five hundredths for those of the communes and two for those of private owners—giving a gross total of about twenty million cubic metres of timber, divided as follows: Timber and working woods two million, and fuel, eighteen million cubic metres. These resources are now increasing, in consequence of the numerous improvements in the management of forests and of increased facilities for transporting from a distance. The above and some of the succeeding statistics are extracted from an admirable report by De Gayffier, a member of the Admission Committee of Class Forty-one. Notwithstanding, however, all the improvements which have been made and the extensive replanting of the Alps, the Pyrenees and other districts, the production is still far from sufficient to supply the demands of consumption, and the deficiency is supplied by importations from Norway, Russia, Germany and Italy. The importation of common woods of all kinds, which in eighteen hundred and fifty-five did not amount in value to seventy million of francs, was valued at one hundred and fifty-four million francs in eghteen hundred and sixty-five.

The annual consumption of wood in France is as follows:

First—In timber for construction purposes and wood used in manufactures:

Consumers.	Cubic metres.
The naval and mercantile marine	118,000
Artillery and engineering	30,000
Railways	600,000
Building	1.600,000
Lath wood and espaliers, etc	3,700,000
River navigation, carriage building, furniture, utensils, etc	4,300,000
Total	10,348,000

Second—Firewood, thirty millions of steres; and charcoal, fifteen millions of steres*.

One of the largest tree sections shown from France was a white oak from Auvergne, which measured six meters in circumference—a little

* A *stere* consists of three hundred and fifty-three thousand one hundred and seventy-four feet.

over six feet in diameter—and was two hundred and thirty-seven years old. The mountains of the Vosges afford sections of firs nearly five feet diameter, and near them in the display were sections of the pine which has been so successfully planted along the sandy barrens of the seacoast. These trees grow with great rapidity, and annually add one centimetre to their thickness, so that in one hundred years they will attain a diameter of about three feet.

THE FOREST EXHIBITION OF BRAZIL.

Next to the exhibition of the woods of Franee, that made by Brazil was perhaps the most attractive by its peeuliar arrangement. A room twenty-five feet square, lighted from above, was devoted to these woods alone. The walls and ceiling were painted in imitation of the natural forest. You saw around you the plants and trees of the Amazon, with their gorgeous foliage. The spaces between the branches and leaves overhead were cut out and shaded so as to give a subdued light, like that in the deep reeesses of the forest.

In the center of this room the specimens of wood were displayed in a grand pyramidal pile. Each tree was shown by a portion of its trunk, of full size and about two feet long. The ends of each were cut in three different directions, so as to show a cross section, an oblique section and one parallel with the grain. One half of the cut surfaces were polished and varnished. The bark was left on, so that the whole outward appearance of the trunk was preserved. A label was attached to each specimen, giving the common name and the botanical name, according to Endlicher.

THE FOREST PRODUCTS OF CANADA.

Canada made a very respeetable show of its resources in lumber of various kinds. There were sections of the principal trees, with their bark, in great number. They were usually about two feet long, and were super-imposed one upon another, so as to make a base for several columns of square logs, of different woods for building purposes, set up about eight feet apart. These supported above a square timber of yellow pine, fifty feet long and ten feet square. The niches formed by this disposition of the timber were filled with smaller specimens, and by panels of dressed and polished planks of pine, white wood, walnut and birch. The Abbé Brunet, of Quebec, Canada, sent a fine collection of Canadian woods, with herbaria and a series of photographs of trees and of plantations. He made the whole complete and instructive by a printed catalogue of sixty-four pages, which contained a large amount of valuable information upon the trees of Canada. This collection, for its uniformity, neatness and pleasing appearance, was one of the most attractive in the Exhibition, and it received a gold medal.

The woods were shown not only in sections but in polished planks about two feet long and eighteen inches wide. The most noticeable were the blistered black walnuts and the birdseye maple, the blistered ash and the oak. The following were given as the prices, per cubic foot, of some of these woods:

White pine	$0 12
Blistered maple	20
Blistered ash	15
Blistered oak	30
White cedar	15

Most of these trees attain a height of one hundred and fifty to one hundred and sixty feet, and vary from four to six feet in diameter.

AUSTRALIAN FOREST TREES.

In the Australian section there was an extensive series of logs and polished planks of the *Eucalyptus Araucaria*, the acacia and others. These woods generally are very hard and dense, and as they can all be naturalized in California, and many of them are already introduced, some facts about them have a special interest.

The extensive forest region of Australia commences in the vicinity of Cape Otway and extends, with occasional interruptions, through the southern and eastern part of Victoria, and thence chiefly on the seaward slopes, through East Australia, a distance altogether of about three thousand miles. Throughout this region the vegetation assimilates more than elsewhere to the floral features of continental and insular India. The eucalypt, which preponderate in the forests of the southern ranges, gradually disappear toward the north. Two species of this genus—*Eucalyptus coriacea* and *E. gunnii*—form dense thickets, even at a height of five thousand feet, within a thousand feet of the point where snow rests for the greater part of the year. Both of these species, it is said, would well bear transplanting to other countries in the temperate zone.

It has recently been ascertained that some species of the eucalyptus attain enormous dimensions in the recesses of the Australian forests, and the following observations upon them are extracted from Dr. Mueller's Essay *:

"The marvellous height of some of the Australian, and especially Victorian trees, has become the subject of closer investigation, since of late, particularly through the miners' track, easier access has been afforded to the back gullies of our mountain system. Some astounding data, supported by actual measurements, are now on record. The highest tree previously known was a *Karri-Eucalyptus* (*Eucalyptus colossea*) measured by Mr. Pemberton Walcott, in one of the delightful glens of the Warren River of Western Australia, where it rises approximately four hundred feet high. Into the hollow trunk of this karri three riders, with an additional pack horse, could enter and turn in it without dismounting.

"On the desire of the writer of these pages, Mr. D. Boyle measured a fallen tree of *Eucalyptus amygdalina*, in the deep recesses of Dandenong, and obtained for it the length of four hundred and twenty feet, with proportions of width indicated in a design of a monumental structure, placed in the Exhibition; while Mr. G. Klein took the measurement of

* *Intercolonial Exhibition Essays*, 1866. *Australian Vegetation, Indigenous or Introduced, considered*, especially in its bearings on the occupation of the Territory, and with a view of unfolding its resources. By Ferdinand Mueller, F. R. S., Director of the State Garden of Melbourne.

a eucalyptus on the Black Spur, ten miles distant from Healesville, four hundred and eighty feet high.

"Mr. E. B. Heyne obtained at Dandenong the following measurements of a tree of *Eucalyptus amygdalina:*

Measurement.	Feet.
Length of stem from the base to the first branch	295
Diameter of the stem at the first branch	4
Length of stem from first branch to where its top portion was broken off	70
Diameter of the stem where broken off	3
Total length of stem to place of fracture	365
Girth of stem three feet from the surface	41

"A still thicker tree measured three feet from the base, fifty-three feet in circumference.

"Mr. George W. Robinson ascertained in the back ranges of Berwick the circumference of a tree of *Eucalyptus amygdalina* to be eighty-one feet, at a distance of four feet from the ground, and supposes this eucalypt, toward the sources of the Yarra and Latrobe Rivers, to attain a height of half a thousand feet. The same gentleman found *Fagus Cunninghami* to gain a height of two hundred feet, and a circumference of twenty-three feet.

"Not merely, however, in their stupendous altitude, but also in their celerity of growth, we have, in all probability, to accede to Australian trees the prize. Extensive comparisons instituted in the botanic gardens of this metropolis prove several species of eucalyptus, more particularly *Eucalyptus globulus* and *Eucalyptus obliqua*, as well as certain acacias; for instance, *Acacia decurrens* or *Acacia molissima*, far excelling in their ratio of development any extra-Australian trees, even on dry and exposed spots, such into which spontaneously our blue gum trees would not penetrate. This marvellous quickness of growth, combined with a perfect fitness to resist drought, has rendered many of our trees famed abroad—especially so in countries where the supply of fuel or of hard woods is not readily attainable, or where for raising shelter, like around the cinchona plantations of India, the early and copious command of tall vegetation is of imperative importance. To us here this ought to be a subject of manifold significance. I scarcely need refer to the fact that for numerous unemployed persons the gathering of eucalyptus seeds—of which a pound weight suffices to raise many thousand trees—might be a source of lucrative and extensive employment; but on this I wish to dwell, that in Australian vegetation we probably possess the means of obliterating the rainless zones of the globe, to spread at last woods over our deserts, and thereby to mitigate the distressing drought, and to annihilate perhaps even that occasionally excessive dry heat evolved by the sun's rays from the naked ground throughout extensive regions of the interior, and wafted with the current of air to the east and south—miseries from which the prevalence of sea breezes renders the more littoral tracts of West and North Australia almost free. But in the economy of nature the trees, beyond affording shade and shelter, and retaining humidity to the soil, serve other great purposes. Trees, ever active in

sending their roots to the depths, draw unceasingly from below the surface strata those mineral elements of vegetable nutrition on which the life of plants absolutely depends, and which with every dropping leaf is left as a storage of aliment for the subsequent vegetation. How much lasting good could be effected, then, by mere scattering of seeds of our drought-resisting acacias and eucalypts and casuarinas at the termination of the hot season along any water course, or even along the crevices of rocks, or over bare sands or hard clays, after refreshing showers. Even the rugged escarpments of the desolate ranges of Tunis, Algiers and Morocco might become wooded; even the Sahara itself, if it could not be conquered and rendered habitable, might have the extent of its oases vastly augmented; fertility might be secured again to the Holy Land, and rain to the Asiatic plateau or the desert of Atacama, or timber and fuel be furnished to Natal and La Plata. An experiment instituted on a bare ridge near our metropolis demonstrates what may be done."

OTHER FOREST EXHIBITIONS.

The other colonies of Great Britain, especially the Indies, were well represented by large collections of the woods peculiar to each.

Norway sent a large assortment of worked lumber, such as planks, joists, flooring boards and mouldings. There are in this country three thousand three hundred sawmills, which employ eight thousand workmen. In eighteen hundred and sixty-five the exports of lumber amounted to eight hundred and sixty thousand tons, or twenty-six million eight hundred thousand steres, valued, approximately, at forty-five million six hundred thousand francs. A little more than half of this was sawed timber, and this portion was sent chiefly to England and France; the rough lumber is exported to England and Holland. The tongued and grooved stuff, six and one half inches by nine eighths thick, is worth one franc and a half per square metre.

Russia exhibited a fine collection of planks and mouldings, remarkable for their straight grain and freedom from blemishes. Mouldings four inches wide and three quarters of an inch thick are sold for one and a half kopecks the English foot.

Among other interesting exhibits of the various forest trees of that empire was one made in the form of books all of one size. The bark is solid and shows the bark of the tree. The covers are attached by hinges of leather and open in half so as to give two shallow boxes, in which are arranged the foliage, the fruit and the flower of the tree, together with the characteristic mosses and lichens of the trunk, and a specimen of the coal.

The name of the plant is printed upon morocco titles, which are attached in recesses cut in the bark of the back. This is one of the most pleasing methods of preparing and preserving a collection of native woods, and this notice may induce some of our amateurs to undertake the preparation of a similar collection for California at some future Exhibition.

The Grand Duchy of Finland sent a very interesting collection of woods, with a descriptive catalogue, from which much valuable information may be obtained.

AUSTRIAN FORESTS.

The woods and fruits of this State are considered as among the first in value of its natural productions. For variety, quality and cheapness

they are hardly rivaled in Europe. The Adriatic Sea, the River Vistula, which flows into the Baltic, the Elbe, which empties into the North Sea, and the rivers which reach the Black Sea, as well as the railroads, all give facilities for cheap transportation. With these advantages, the exportation of wood has been constantly increasing until it has reached a total value of seventy-five millions of francs.

The quantity of timber sent by the Administrator of Forests of the different States of Austria was so great that it could not be exhibited in the building, and it was therefore grouped outside in the *annexe*. The trunks of trees were cut into convenient lengths, which were reunited on the ground, so that their full dimensions were shown. The principal trees were oaks and spruces. Among them *Quercus pedunculata* and *Abies excelsa* are most conspicuous. The former is five feet in diameter at the butt, and is interesting as the wood which is largely used for the manufacture of wine and beer casks and barrels. A great number of staves of all sizes were shown in connection with the unworked woods. Some of these are fifteen feet long and are intended for a grand cask to hold one hundred thousand French litres. There are several agencies in Paris for the sale of these staves. This oak grows in deep alluvial soils and forms thick forests, in which the trees attain a height of more than one hundred feet, and a diameter of from four to five feet.

THE UNITED STATES.

In the midst of all these extensive and careful representations of the forest resources of the various countries, the citizen of the United States was mortified at the meagreness of our exhibition in the same line. All that we had to show of our vast forests, full of the choicest timber, could be laid upon a table ten feet long and three feet wide. There were two bundles of very good shingles from the far West, a few irregular bits of American wood, and the laurel panels and door from Boyd, of California. These last were very beautiful, but did not appear to have attracted the attention they deserved.

There was not any ornamental door in the exhibition equal to that sent from California, either in accuracy of carpentry or for beauty of grain and general finish. It was a fine exhibition of the remarkable capacity of the wood of the madrona for taking stains, in imitation either of mahogany, rosewood or black walnut.

A section of the great tree—the *Sequoia gigantea*—would have attracted great attention from all persons, and would have fully redeemed the extreme paucity of the United States display of forest products. It is to be regretted, also, that the samples of our ordinary commercial wood, such as the pine, redwood, cedar and fir were not sent on as intended.

CORK.

This is a forest product which is of great importance to the wine interest of California; and as it is possible that the cork tree might be introduced there with advantage, a few details will not be uninteresting.

The principal exhibition of cork was from Algeria, and consisted of slabs of raw "male cork," eight feet six inches long, with some of second growth, fifteen feet six inches long, and specimens of raw cork bark of second growth, eight years old. Some of these slabs were from four

to eight inches thick. The following explanatory statement is taken from the report of DeGayffier:

"Cork is the substance lying beneath the true bark of a particular kind of oak, called the cork oak, which grows principally in Italy, Corsica, Algeria, Spain and the south of France. The tree begins to furnish cork at the age of from twelve to fifteen years; but the first cork is of poor quality, and only fit to make floats and other coarse objects, and Spanish black, which is nothing more than cork burned in close vessels. After the first layer has been removed from the tree the cork bark is deposited with more regularity, and then yields material fit for the finer purposes, such as the making of wine and other corks, sheets and other well-known objects used for many purposes."

From the period already mentioned the bark may be removed from the tree once in eight or ten years, and the same tree will yield cork twelve or fifteen times. Raw cork, or that which has merely been rasped, comes principally from Italy, Spain, Portugal and Algeria. Spain supplies nearly the whole of the manufactured cork of commerce. Seville is the most important entrepot of this product. The importations into France in eighteen hundred and fifty-five were five hundred and thirty-two and a half tons, valued at two hundred and fifty-seven thousand two hundred and twenty-four francs. In eighteen hundred and sixty-five they had increased to three thousand eight hundred and fifty-five tons, valued at two millions five hundred and two thousand six hundred and ninety-six francs. The export amounted to one hundred and sixty-nine and a half tons in eighteen hundred and fifty-five, and in eighteen hundred and sixty-five it had reached the figure of one thousand three hundred and nineteen and a half tons, of the total value of one million two hundred and thirty-six thousand nine hundred francs.

The Government of France has encouraged the development of the riches of the cork forests of Algeria by giving long leases on merely nominal terms to several companies. Large sums have already been expended there in the preliminary barking of the trees, but as yet there has not been that measure of success that was anticipated. The natives have shown their ill will by burning several of the forests, and some of these enterprises have been abandoned.

RESINS.

The following data upon the sources and consumption of resin in France are from the report of De Gayffier:

"The maritime pine tree is the only tree in France from which resin is extracted. The cultivation of this tree constitutes the principal, if not the only wealth of the district lying between Bordeaux and Bayonne. According to the nature of the soil, the pine is tapped for resin between the ages of twenty and forty years. The operation consists in making long incisions in the trunk, whence the resin exudes and is collected in various ways. The natural results of the bleeding of the pine trees are: The soft gum, or resin, which, by distillation, yields turpentine; the *galipots*, an almost solid substance, which, by evaporation, forms in stalactites all down the tree; the *crottas*, a mixture of the two former products; the *varras*, which are the *galipots* entirely dry and ad-

hering to the tree. A pine tree, sixty to seventy years old, furnishes, on an average, about six to eight kilogrammes (fifteen to twenty pounds) of raw material, of which about one third is *galipots* and *varras*. The American war gave a great impulse to the resin trade. The following statistics will give an idea of the results: In eighteen hundred and fifty-five the exports of French resin did not amount to more than four thousand one hundred and thirty-three tons, of the total value of two million two hundred and fifty thousand francs. In eighteen hundred and sixty-five they had risen to the enormous total of five thousand two hundred and fifty tons, worth twenty-seven million two hundred thousand francs. The importations in eighteen hundred and sixty-five amounted to two thousand nine hundred and sixty tons, of the value of two million four hundred thousand francs."

STAVES.

The wood employed in this manufacture is called "merrain," and is split out by means of a tool called a coulter. They are made of all sizes, from eight inches to one hundred and seventeen in length, and from three to ten inches wide, and from one eighth to three eighths or more in thickness. They are chiefly produced in Germany, Russia, Turkey and the United States. The coopers of Europe are largely supplied from the United States. The best woods are oak and chestnut. White mulberry is used in Languedoc. The importation in France in eighteen hundred and sixty-five amounted to thirty-seven million six hundred thousand pieces, valued at twenty-six million three hundred thousand francs. Nearly the whole of this is consumed in the country.—*Condensed from De Gayffier's Report.*

OSIERS.

In France the osier is the chief material used in the basket trade, which is carried on chiefly in the valleys of Ver, Aubeaton and Hirson, in the Aisne, where osiers grow in large quantities. According to De Gayffier's report, accompanying the French exhibitions in this class: "In the Arrondissement of Verrins alone there are three thousand families engaged in basket making, who produce more than two million five hundred thousand francs worth annually, two thirds of which are exported to England and America. The importations amounted in eighteen hundred and fifty-five to one hundred and five tons, of a total value of three hundred and twenty-one thousand francs; and in eighteen hundred and sixty-five only to fifty-nine tons, of the value of fifty-three thousand francs. The importation of osiers in bundles, which in eighteen hundred and fifty-five was one hundred and five tons, had risen in eighteen hundred and sixty-five to one hundred and eighty tons, of the value of twenty-two thousand francs. The exports grew in the same period from fifty-nine tons to seventeen hundred tons, the value of the last named total being estimated at three hundred and seventy thousand francs."

The production of osiers, and the manufacture of baskets and hampers for fruits, vegetables and wines in bottle, will probably soon become an important industry in California.

MANUFACTURE OF PAPER FROM WOOD.

One of the most interesting exhibitions consisted of a machine in

action for the preparation of paper pulp, or stock from ordinary sof wood. This machine was constructed at the establishment of Decke Brothers & Co., at Canstatt, Wurtemberg, and was shown in the Parl in a separate building. It is the invention of Henry Welter, paper man ufacturer at Heidenheim, and was shown by himself and the construct ors jointly. It is quite an extensive affair, and occupied considerabl space, but was arranged so that the crowd always attracted to it coul ascend by a broad stairway on one side of the machinery, and descen by a similar staircase on the other side. Billets of wood, cut and spli to about the size ordinarily used in fireplaces, were constantly fed to th machine at one end, and by means of a large rasping or grinding cy inder were rapidly ground or torn into shreds and pulp, which wa washed in water and finally delivered in several degrees of fineness a the other end. This paste is quite white and soft, and is used to a grea extent to mix with the stock or pulp obtained from rags. Specimens c printing, writing and packing papers were shown, which containe twenty-five to sixty-six per cent. of this paste. There are already ove thirty establishments in Germany for the manufacture of paper pul from wood. This machine received a gold medal.

CHAPTER III.

IRON, STEEL, COPPER, ZINC, AND OTHER USEFUL METALS OF THE EXPOSITION.

IRON AND STEEL.

It was almost impossible to see and it is much less possible to describe all that was shown in this department. Nearly every country sent something that claimed attention, and Great Britain, France, Prussia, Austria and Russia made overwhelming displays of iron in all its stages of manufacture, from the rough ore to the pig of all grades; bar and plate iron; steel in ingots, bars, or rolled out or drawn into wire. Each iron-producing country seemed to vie with every other in the exhibition of the strength and fiber of its wrought iron and steel. Cases upon cases were filled up with bars of various sizes that had been bent, twisted and broken so as to display the grain to the best advantage. Wrought iron rods and bars and railway axles were shown twisted into every imaginable shape. Great round bars, from three to eight inches thick, were tied into knots. Railway iron was twisted until it looked like a long screw, and all without a crack or parting a fibre.

It is a satisfaction to know that the scientific and practical discussion of this subject has fallen into the hands of Mr. A. S. Hewitt, of New York, one of the Commissioners, who has a very complete and valuable report in preparation for our Government.

The United States, though not by any means fully represented in this department, had a very creditable display for variety and for purity and practical value. There were some large masses from the Iron Mountain of Missouri, and some from Lake Superior, and a few masses of the magnetic and specular ores of Northern New York. The specular ore of Sierra County, in our State, was also found in the Exhibition, and it was as pure and excellent in quality as any. The Peninsular Iron Company, of Detroit, Michigan, sent a suite of specimens of Lake Superior charcoal pig iron: No. 1, suitable for foundry purposes; No. 2, rolling mill iron; No. 3, car wheel iron; No. 4, mottled, for malleable purposes; No. 5, valuable for making malleable iron and for rolling mill purposes.

The Franklinite ore and metal was shown in connection with the

zinc ores and products of the New Jersey Zinc Company. The hard white iron made from this ore has already been imported and used in California, by the Union Iron Works, for making stamp shoes and dies and the jaws of rock crushers.

Messrs. Park & Brother, of the Black Diamond Steel Works, Pittsburg, Pennsylvania, made a fine exhibition of cast steel in bars, round, octagonal and flat, made at their works. It was accompanied by beautifully finished edge tools made from their steel.

SWEDISH IRON.

In the exhibition of ores, Sweden took the lead, not only in bulk of specimens, but in the richness and purity of the ore. Prussia exhibited a splendid suite of evenly trimmed specimens of the various kinds of ore used, chiefly brown iron ore and spathic iron (the carbonate).

The samples of Swedish magnetic ores were in such masses that some had to be left in the yard. They were about three feet long, and must have weighed a ton or two each. Ten of these were counted, and there was in addition, in the machine gallery, a grand pyramidal stack of iron and steel bars standing upon a foundation of blocks of ore from the various Swedish mines. The various pig irons were arranged in a tier just above the ore, and above this tier the steel and iron bars of all sizes and shapes were stacked up. The iron ores received the gold medal, the steel bars a silver medal, and the iron a bronze medal.

KRUPP'S STEEL.

The most extensive and the most costly display of steel, raw and manufactured, was sent by F. Krupp, of Essen, Rhenish Prussia. The Jury awarded him the grand prize. Krupp's works and manufactures are world renowned, and some statistical data in regard to them may be interesting.

The establishment has been in existence for the last forty years, and has been gradually developing and increasing until at the present time the works cover continuously a surface of about four hundred and fifty acres (English), two hundred of which are under roof. In these works eight thousand men are employed, in addition to two thousand more at the blast furnaces and iron pits on the Rhine and in Nassau. These works produced in eighteen hundred and sixty-six manufactures of steel of the aggregated weight of sixty-one thousand tons by means of four hundred and twelve smelting, reverberatory and cementing furnaces, one hundred and ninety-five steam engines, from two to one thousand horse power each, forty-nine steam hammers, one hundred and ten forges, three hundred and eighteen lathes, one hundred and eleven planing machines, sixty-one cutting and shaping machines, and many others of less consequence. No less than one hundred and twenty steam boilers are required to keep the engines in operation, and they evaporate one hundred and fifty thousand cubic feet of water in twenty-four hours.

The yearly production is valued at over seven million five hundred thousand dollars, and the various objects manufactured are distributed all over the world.

The representation in Paris consisted of some twenty or thirty large objects, of which the most prominent was a cylindrical cast steel ingot weighing forty tons, fifty-six inches in diameter, and standing nearly twelve feet high. It was forged at one end into an octagonal shape, and is

intended for a marine crank shaft. This huge block of crucible steel is the largest that has yet been made. In the first London Exhibition a block of two and one quarter tons weight was regarded with wonder, and received the only Council medal in the department of steel products. At the former Paris Exhibition a block of five tons was shown, and to the London Exhibition of eighteen hundred and sixty-two one of twenty tons was sent. This shows the rapid progress made in the scale of Krupp's operations with large masses of steel. The upper end of this monster ingot of forty tons was broken across so as to show the grain. One half of this broken surface had been ground down and polished as bright as a mirror, without developing the least defect or flaw. Not content with this proof of the density and uniformity of the ingot, they had cut a gash in the side about half way up, and taken out a chip about as large as one man could lift, and polished it, with satisfactory results.

To shape this great ingot a hammer weighing fifty tons was used. All the cast steel productions of the establishment, with the exception of disk centres for car wheels, are made from ingots of a greater or lesser weight and with a round or square section.

The large ingot stood upon a semi-circular platform, and served as a centre piece for a group of pieces of shafting, highly wrought, for locomotive wheels and tires, for guns and gun carriages, and many other objects of wrought and unwrought steel. Opposite all this was the monster gun, also made of cast steel, weighing fifty tons. It is intended for coast defence against the attacks of iron-clads. It consists of an inner tube upon which are shrunk cast steel rings, which were made like railway tires and without welding. The diameter of the bore is fourteen inches; and as it is a breech-loader, the perfection of the bore and rifling may be seen by looking through the gun at the muzzle. It has forty rifle grooves. This gun was in process of manufacture day and night for sixteen months without interruption. The railways had no cars strong enough to transport it to the Exposition, so the establishment was obliged to construct its own car, which was made entirely out of cast steel and has twelve wheels. It weighs twenty-four tons. The gun is for sale and is valued at one hundred and eight thousand seven hundred and fifty dollars.

Cast steel railway tires form a very considerable portion of the manufacture of this establishment. They make about forty thousand a year, over a third of which are for English, Indian and American railways. They are made out of one piece of steel without welding, and in the following manner: Large ingots are forged out into flat lengths, from which are cut rectangular pieces corresponding with the height of the proposed tire. These pieces are then split down the centre to within a certain distance of each end; wedges are inserted, the slit opened out so that the bar is gradually, under the hammers, converted into a ring, which is at last formed into a tire between powerful rollers.

Among the many other objects worthy of note were the "angle rings" for steam boilers. These are made after the same method as the tires, and are very perfect specimens of machine forging. One, with a diameter of ninety-six inches, weighed four hundred and eighty-three pounds. They are sold at the works at two hundred and twenty-five francs per one hundred kilogrammes, and any size will be made to order. Cast steel railway bars are also one of the chief objects of manufacture of the works. They are made from steel of second quality and are afforded at a comparatively low price—about half as much more as the cost of an

iron rail. The durability is greatly superior. Krupp can now supply such rails at forty francs the kilogramme, but I have heard that there is a new process by which the cost is to be much reduced.

BOCHUM COMPANY—STEEL PRODUCTS.

Next to the exhibition of Krupp, which may be styled as princely, the display made by the Bochum Company of Westphalia, Prussia, was most interesting. This company also make large objects of cast steel, and exhibited railway tires, shafts, axles and some remarkably large bells, one of which is nearly ten feet in diameter and weighs fourteen thousand seven hundred and fifty kilogrammes. One of the most striking objects was a string of railway car wheels, twenty-two in number, all cast together at one operation, the junction being from hub to hub and by one single connecting sprue at the bottom. When they are taken out of the sand they are centred and mounted in a lathe as one piece and then turned up on the edges.

It is claimed by this company that its cast steel wheels will run on an average fifty-seven thousand kilometres without requiring any repair. One of the railway companies certifies that the puddled steel tires suffer a wear of one sixteenth of an inch in running twelve thousand kilometres, while the cast steel wheels of Bochum Company will run thirty-nine thousand two hundred and forty-eight kilometres before they are worn to an equal extent. It would be interesting to know how they compare with our chilled face car wheels.

FRANCE.

The French exhibit of iron and steel was very fine. Their largest steel ingot, however, weighed only twenty-five thousand kilogrammes. It was broken across and showed a very homogeneous fracture. Some of their cast steel tires made without welding, upon Krupp's method, were twelve feet in diameter. A cast steel cannon weighed sixteen tons, and was turned up and polished all over. They showed sheets of rolled cast steel that were twenty-two feet long, six feet wide and half an inch thick. A large part of this display was in a separate building in the Park, and was very complete and extensive.

FORGED IRON.

In forged iron, for ornamental and decorative purposes, the Exposition was very rich. There was a long line of gates and sections of fence placed between the Exposition grounds and the reserved garden. Some of them were beautiful in design, and wonderful in their sharpness and accuracy of finish. The peculiar construction of French dwellings, with an inside court shut out from the public streets or avenues, makes a demand for highly ornamental and somewhat costly entrance gates, which does not exist with us.

ORNAMENTAL CASTINGS.

The use of cast iron for ornamental purposes has evidently made great progress. The substitution of iron for bronze in artistic productions is of comparatively recent date, yet the visitor who saw the results in the Exhibition was compelled to acknowledge that iron will in the future be substituted to a great extent for the alloys of copper, in the production

of large ornamental or monumental works. As an evidence of this, we had the splendid monumental fountain and groups of figures of animals, on one side of the grand entrance to the Park, from the foundries of Durenne, and inside the building extensive displays of statues, busts, vases, stags' heads with antlers, and a variety of tablets and smaller objects. From another establishment there was a splendid series of figures and groups of life size, most of them Scripture subjects for the adornment of churches. One group, for example, represented the Crucifixion, with the Savior and the two thieves of life size. The form and spirit which the sculptor gives to the model was rendered perfectly in the rigid iron. Almost all of these objects were shown as they came from the mould. The surfaces were perfectly smooth and even, and visitors were amazed at the accuracy with which the different parts of the mould were brought together. The suture lines are sometimes hardly visible; again they appear as thin films rising from the surface, so that they may be dressed away without injury to the figure. They are all cast hollow, and the cores were supported by iron rods or wire.

There was no evidence in the Exposition of an extensive application of cast iron to architectural decoration. It is true that the building was in great part made of iron, but there was little attempt at ornamentation. The material does not appear to be used anywhere in Europe as freely and with such fine architectural results as in the United States, and especially in California The railway stations generally are wonderful structures of iron and glass, but there is comparatively little attempt in them at artistic display.

ACCURATE GAUGES.

In the display of ordnance and munitions of war made by Whitworth, of England, there were some very interesting longitudinal sections of guns and rifles, which showed the remarkable perfection of the bore and rifling. This distinguished mechanic is known to produce some of the most accurate of gauges, and a few specimens are shown to illustrate them. A stout steel ring is handed to you through which you can pass a polished steel cylinder about half an inch in diameter. The fit is so perfect that it requires a little pressure to pass the cylinder through from end to end, and this pressure must be applied in the line of the axis; the least pressure upon the sides of the ring appears to bind upon the cylinder. You next take a second cylinder, apparently exactly the same size as the first. This passes through the ring with perfect ease, and, compared with the other, it is a very loose fit. Now the difference in diameter of these two cylinders is the 5-1000th part of an inch. Two perfectly plane surfaces of cast steel were shown. One of these slides about over the other upon a thin film or cushion of air. If by a little effort the air is excluded the plates are inseparable by a direct pull. One may be lifted by the other.

In the same building in which Whitworth's ordnance was shown "John Brown & Co., limited," exhibited a bar of steel, an armor plate, thirty feet long, three feet six inches wide and six inches thick, weighing eleven tons. It was planed as true as a ruler on the edges and ends, and appeared to be compact and homogeneous throughout.

COPPER AND ZINC.

The most attractive display of copper in its raw state was from Lake Superior. The collection consisted of crystallized native copper, and of the various interesting minerals and crystallizations which accompany it. There were also some of the products of smelting and a stack of the metal in ingots of a brilliant red color, like that of the celebrated copper bars of Japan, some of which may be seen in the representation of that Empire. The various copper ores of California were displayed in the same and an adjoining case with the Lake Superior specimens, but were more interesting for their number and variety than for their beauty. The brilliant mass of variegated ores from Plumas County, and the wonderfully rich and pure masses of red oxide of copper from the old Arizona mine, were most admired. Neither Union or Keystone, the Newton and the Cosmopolitan or the Del Norte County mining companies did themselves justice in not sending a complete suite of their different grades of ore. As it is, the few specimens that were in the Exhibition will at least gain the mines a place in the catalogue and a mention, perhaps, in the official reports to the various Governments. A series of specimens from each of our leading California mines, trimmed to a uniform size, say into blocks about eight inches square, would have made an array of rich ores far finer than any other display of copper in the Exposition.

The duty of making an official report to the United States upon the copper of the Exhibition devolves upon Mr. H. Q. D'Aligny, of Lake Superior, a mining engineer and one of the United States Commissioners, who had general direction and care of the mineral department of the United States in the Exposition since the opening. This report, with the others upon other portions of the Exposition, will be made this Winter, and will probably be printed in the Spring at Washington. Although the collection from Lake Superior was quite good, as respects variety, there were no very large masses, and no effort appears to have been made by the mining companies to send any. As a consequence, Russia has the credit of sending the largest mass of native copper, weighing fifteen hundred and sixty pounds. It was sent by Nicolas and Alexander Popoff, from the distant Kirghiz Steppes in Siberia. In this mass the sharp eyesight of Descloizeaux, the distinguished French mineralogist, detected an isolated grain of native silver. This is exceedingly interesting to mineralogists, for it shows the same association of the metals in Siberia as at Lake Superior, and it indicates a similarity in the deposits and in their origin. It is generally known to mineralogists in California, although it may not be a familiar fact, that at Lake Superior large lumps of pure silver are found in the midst of masses of copper, the two metals being as perfectly united as if soldered, yet there is no mingling or alloy at the junction. It is now generally conceded that these metals were deposited from solutions, under the influence of electrical currents. It is quite probable that native silver will be found with the copper of Alaska. I have seen very large masses of copper from that place, and there is every reason to believe that we will find there copper deposits fully equal to those of Lake Superior.

MINES OF PRINCE DEMIDOFF, SIBERIA.

Paul Demidoff, of Siberia, sent a large collection of the products of his various mines of copper, iron, gold and platinum. His property ex-

tends on both slopes of the Ural Mountains, and comprises over a million and a half of acres of mineral and forest lands, with a population of fifty-four thousand persons. In this estate there are twenty-four copper mines, all in operation, one hundred and seven gold veins, and twenty mines of platina. The copper mine of Medno-Roudiansk, discovered in eighteen hundred and fourteen, has yielded nearly a million of pounds of fine copper, and is worked to a depth of five hundred and seventy-four feet. This is the mine that affords the beautiful malachite. This mineral was discovered in eighteen hundred and forty in an enormous mass, and over seventy thousand pounds have been taken from it. The fragment sent to the Exhibition is five or six feet long and nearly three feet thick. It weighs four thousand six hundred and eighty-six pounds, and is valued at fifteen thousand dollars. The portions of this mass which have been polished reveal a very beautiful grain and a fine color.

The Prince has twenty-four copper smelting furnaces on the estate, some of which smelt thirty-five tons of ore in twenty-four hours.

MALACHITE FROM QUEENSLAND.

Another large mass of malachite in the Exhibition was contributed from Queensland, by the Peak Downs Copper Company. This specimen was nearly six feet long, three feet wide and one and a half thick. Its weight was not stated. It is rather dark colored and is not as solid as the specimens from Siberia.

The famous Burra Burra mines of South Australia were not fully represented; but there was an extremely interesting collection of the beautiful blue carbonate crystals associated with malachite.

There were some very fine malachite vases, from one to three feet high, sent from different establishments in Russia, besides paper-weights, inkstands and a variety of small ornamental objects, attractive in appearance and excellent in workmanship.

The English and Australia Copper Company made a good exhibition of their products in bars and slabs of refined copper and ordinary black copper, for which they obtained a bronze medal.

COPPER ORES OF CHILE.

Chile made a very heavy exhibition of copper ores. They were sent in great masses and were piled together in magnificent confusion, with the figure of a miner in full costume standing at one end of the heap as if upon guard. These blocks were chiefly yellow copper ore and the variegated ore, with some gray copper and some masses of cupriferous silver ores. The copper mines are the most important and profitable in Chile and employ the greatest number of workmen, as the following facts will show. There are now in actual working or development one thousand six hundred and sixty-eight copper mines, two hundred and sixty-eight silver mines, six hundred and sixty-eight coal mines, and the total number of miners is twenty-three thousand seven hundred and forty-three. In eighteen hundred and sixty-three there were three hundred and forty-seven high or cupola furnaces for the smelting or fusion of copper ores. The provinces richest in copper and silver ores are those of Atacama and of Serena in the north. They afford nearly three-quarters of the annual production of the country. The most important mines, also, are not far from the coast, and are connected by

railroad with some of the best ports, so that the facilities of transport and exportation are great and comparatively inexpensive. Copper and its ores are, however, not confined to any particular part of the State, but are very generally distributed in the interior along the Andes, from Talco in the south to Majellones in the north, or over a distance of nearly twelve degrees of latitude.

The value of copper and its ores exported from Chile in eighteen hundred and sixty-five was over fourteen million dollars, most of which went to England. A large part of it is sent in the form of matte (concentrated ore by fusion), and some in the form of bars and ingots.

DECADENCE OF THE ENGLISH MINES.

The production of copper ores in Cornwall has been steadily diminishing and now many of the mines are closed, for they can no longer be worked with profit while the price of copper is so low. The mines are in general very deep, and the ores very poor when compared with those of California, Chile and other parts of the world.

There were very few exhibitions of these ores, or from the extensive copper smelting establishments of Great Britain. In one small collection from Swansea I saw samples of our ores from Calaveras County and from the Colorado River.

COPPER SMELTING FURNACES.

There were several extremely interesting collections of copper in its various stages of progress by smelting from the ore up to the refined or rose copper for use. These collections show not only the metal in its various stages, but the fluxes, the scoriæ and the fuel used. They were accompanied by carefully made models of the furnaces employed. The models were so constructed that they could be opened into two portions, and thus not only show the exterior but the interior construction. They are carefully made to a scale and are intended to serve as guides for the erection of large furnaces. They would be of great service to us in California, and I have regretted that the State has no institution provided with a fund which might be applied to the purchase of such models for the benefit of our mining population and the instruction of our young men who are turning their attention to mining and metallurgy.

MANSFIELD COPPER SCHISTS.

The company occupied in the working of the Mansfield copper schists made a fine display of the products of the mines and of their works for the manufacture of sheet copper and copper boilers. The production of the mines in eighteen hundred and sixty-six was not less than twenty-one thousand seven hundred and twelve quintals of rosette copper, and twenty-four thousand five hundred and fifty-four quintals of refined copper. Among the articles of manufactured copper there was a sheet nineteen feet nine inches long and nine feet wide, weighing four and a half pounds to the square foot. Another sheet was ten feet long and three feet wide, and a boiler or kettle eight and a half feet in diameter and three feet deep. It is claimed that the works can turn out copper sheets ten feet wide and thirty feet long. The mines and works of this company give occupation to five thousand five hundred men.

ZINC ORES AND MANUFACTURES.

The principal exhibitions of this metal and its products were made by the Prussian and French companies, foremost of which is the Vielle-Montagne. This company is not exclusively occupied with zinc mines; it owns, also, deposits of lead, iron pyrites and coal. It has establishments in Germany, Belgium, France and Sweden. It employs in all six thousand two hundred and twenty-three workmen, of whom two thousand six hundred and ninety-three are in Belgium. It produces seventy thousand tons of zinc ores annually, two thousand seven hundred tons of lead ores, two thousand tons of copper ores, and one hundred and ten thousand tons of coal. Its manufactures are: metallic zinc, thirty-two thousand tons; sheet zinc, twenty-five thousand tons—besides some eight hundred tons of zinc nails and small articles. The manufacture of zinc-white—the white oxide of zinc—used for painting, has reached the figure of six thousand tons. The sales of the company per annum are, in round numbers, as follows:

Manufactures.	Tons.	Value in francs.
Metallic zinc	35,200	26,400,000
Zinc white	5,800	4,327;500
Ores of lead, etc	.....	1,055,000

The white zinc is made near Paris, by the combustion of the metal, and not directly from the ore, as by the American method. The specimens of ore exposed by the company consist chiefly of blende—the sulphuret of zinc—in large masses weighing from four hundred to eight hundred and one thousand pounds each. This company has a formidable competitor in the Silesian Zinc Company, of Breslau, which was established in eighteen hundred and fifty-three with a capital of five million Prussian thalers, since then increased to ten millions. One of the chief merits which this company claims for its zinc is that it is all made from calamine and not from blende, and is therefore supposed to be free from sulphur and to be stronger and more ductile. There was a very fine show of zinc plates, corrugated sheets for roofs, perforated plates, nails, wire and tubes. The largest plate was seventeen feet long and fifty-four inches wide, and three quarters of an inch thick, and it weighed two thousand and one hundred pounds. It could have been made twice as long and heavy, if the space had been allowed for it. The new Exchange building at Berlin is roofed with the corrugated zinc plates of this company's manufacture.

AMERICAN ZINC.

But in all the zinc exhibited by these two companies, and several others, there was none equal in quality to that produced by Wharton from the ores of Lehigh County, Pennsylvania, and exhibited by him in the American section. This zinc is nearly chemically pure, and may be used as such in analysis when testing for arsenic.

The New Jersey Zinc Company, of New York, was represented there by samples of the ores from the mines of Sterling Hill and Franklin, New Jersey, and by the products of the works at Newark. These con-

sisted chiefly of white zinc, dry and ground in oil for paint, and of the hard white, manganiferous iron, generally known as "Franklinite" iron. This industry of zinc and iron combined has assumed large proportions and is very successful. It was founded chiefly through the exertions and enthusiasm of James L. Curtis, of the City of New York, who early had a correct appreciation of the importance and value of these ores and of zinc oxide for paint as compared with poisonous lead, long before the incredulous public could be convinced.

I do not know of any extensive deposits of calamine in California. There are some localities of blende, but it is not probable that they can be worked to advantage for several years to come.

NICKEL AND COBALT.

Information in regard to the ores of these metals and the products manufactured from them is of some special interest to California, inasmuch as we have a locality of such ores in abundance at or near the top of the Sierra Nevada. These were represented in the collection by the specimens given by Mr. Gaskill.

There were numerous exhibitions of nickel and its ores from various and remote parts of the world. We found specimens from Chile, from Italy, Prussia, Sweden, Austria; also from New Jersey. From the last named locality Messrs. Wharton and Fleitman sent specimens of matte, containing about twelve per cent. of nickel, and some of the ordinary commercial nickel in small cubes, containing seventy-five per cent. of nickel and twenty-five per cent. of copper. This is produced from nickeliferous pyrrhotine (magnetic pyrites) and the sulphuret of nickel; which last occurs in crusts at the Gap mine in Pennsylvania. The pyrites are said to contain only about three per cent of nickel.

The Swedish nickel is produced at Klepwa. This ore is also a mixture of nickeliferous pyrrhotine with ordinary copper pyrites, and is shown in large masses. It appears to be taken from heavy beds. The best ore shows by analysis only 2.75 per cent. of nickel and 0.10 of cobalt. The concentrated matte contains 53.74 per cent. of nickel and 25.46 of copper. The small cubes contain sixty-six per cent. of nickel and thirty-four of copper. Another quality contains seventy-two per cent. of nickel. The establishment produces annually eighty-five thousand kilogrammes of concentrated nickel matte, containing from fifty-three to fifty-six per cent. of nickel and twenty-four to twenty-seven per cent. of copper, seven per cent. of iron and thirteen per cent. of sulphur.

The price of the products varies according to the percentage of nickel. The ordinary matte, containing from fifty to fifty-six per cent. of nickel, is worth 6.70 francs the kilogramme of nickel. For example, one hundred kilogrammes of matte of fifty-four per cent. is worth about three hundred and sixty-two francs. For a sixty per cent. matte the price is about five hundred and four francs for one hundred kilogrammes.

There is another establishment for the production of nickel at Sagmyra, Falun, and it was represented by specimens of ore and the mattes of various degrees of value. Some of the ore is a granular mixture of hornblende with magnetic and copper pyrites, very much like some mixtures in the United States. The best product of these works that was shown is a finely granular matte containing sixty-one per cent. of nickel, thirty-eight per cent. of copper and 0.80 per cent. of iron.

A cobalt and nickel company in Hungary exports a crude product

containing forty-eight per cent. of nickel and cobalt, to England, to the extent of one million kilogrammes a year (about twenty-two hundred tons).

A nickel and cobalt manufacturing establishment at Val-Benoit, near Liege, exhibited its products and sells them at the following prices:

Per kilogramme.	Francs.
Pure nickel	13.00
Ordinary melted nickel	11.50
Black oxide of cobalt	38.00
Rose oxide of cobalt	25.00
Nickel bronze	5.50

In Chile the ores of cobalt are common from the mines of Volcan, in the Province of Santiago, to the north of the Desert of Atacama. It accompanies the copper and the silver ores. At the mine of Buitre, gray cobalt ore is associated with mispickel, etc. Considerable quantities have been exported in the raw state, and the ore is washed in Europe. Danaite, mispickel containing cobalt, is found at San José, Santiago. It is a fibrous variety and contains four per cent. of cobalt. Gray cobalt is found at the same locality; it contains twenty-one per cent. of cobalt.

QUICKSILVER.

The finest display of ores and the metal was made by the Old Almaden Mine of Spain. It sent twenty or thirty solid blocks of cinnabar more than a foot square. This ore is of finer grain than that from New Almaden, but the color is not so brilliant. The Old Almaden ore looks more like the red oxide of iron. A large flask of native quicksilver accompanied the collection.

Algeria sent some very large masses of ore in which the cinnabar is associated with carbonate of lime, very much as in the California mines. This association appears to be as characteristic of cinnabar as that of quartz with gold.

Most of the California localities were represented, but not by large and brilliant specimens.

Old Almaden Mine is worked in a very rude manner, and one of the most ancient single-action steam engines is still in operation there raising water.

LEAD ORES.

The lead ores exhibited were chiefly the sulphuret-galena, and the most extensive displays were in the French, Algerian and Italian sections. Some very large blocks of granular galena were shown from Sardinia, and an interesting series of specimens, showing the ore in the various stages of mechanical preparation—washing and sorting—was exhibited in the English section. As, however, most of these ores are argentiferous, they are noticed more in detail in the succeeding chapter.

One of the great curiosities of lead manufacture was shown in the French section, by M. Letrange, being a coil of lead pipe twenty-eight hundred and fifty metres long (nearly ninety-five hundred feet) with a calibre of only one millimetre (about one twenty-seventh part of an inch).

CHAPTER IV.

GOLD, SILVER, PLATINUM AND THE RARE METALS.

GOLD AND ITS ORES—CALIFORNIA.

The principal mines of California were represented in the collection, as will be seen by reference to the appended catalogue. Although the collection was not as extensive and rich as it should have been, it was very interesting and instructive, and was highly commended for the uniformity of the specimens in size and for the arrangement. The collection sent by Dr. Pigné was also very complete and well classified, and contained specimens from some mines not otherwise represented. Nearly every variety of gold-bearing quartz was shown and generally the different varieties from the same vein, together with specimens of the wall rocks and of the surface or decomposed ore. Most of the specimens were selected so as to show the average character and appearance of the ore as raised and sent to the mills, and thus the display of free gold was not as striking and rich as some persons expected to see. In general, those who visited the California display looked for quantities of gold in nuggets and for trays full of the dust. This would have been very attractive to the crowd, and would have assured people of the already familiar fact—that gold abounds in California. The collection, therefore, was much more valuable and instructive than a great show of gold could have been, and it excited considerable interest and attention. The contrast between the California ores and those from Colorado, arranged in a large case opposite, was very striking—the California specimens being nearly all quite white and showing but little sulphuret of iron, while the Colorado specimens were nearly all of them sulphuret of iron without quartz.

The collection of gold crystals from California belonging to the Commissioner was privately exhibited to the mineralogists and those who could best appreciate them, and they excited great admiration. There is nothing comparable with them, for variety and beauty, in the museums and collections of Europe.

The large crystalline mass of gold from the Spanish Dry Diggings,

California, which was exhibited for a time at San Francisco, in the window of Hickok & Spear, and was photographed by Watkins, is now in Paris, the property of M. Fricot, formerly the owner of the Eureka mine at Grass Valley. Owing to the difficulty and expense of making this unique specimen perfectly safe in the Exposition, it was not entered there, but M. Fricot took pleasure in showing it freely at his house to those most interested.

COLORADO GOLD ORES.

Mr. J. P. Whitney, of Boston, Commissioner from Colorado Territory, made a large display of the auriferous ores of Colorado. They occupied a long wall case, opposite to the central case in which the California collection was displayed, and the contrast between the two collections was very striking. The Colorado ores are nearly all sulphurets of iron, and quartz does not appear. They made a brilliant, sparkling display, and some of the specimens contained considerable quantities of gold visible to the unassisted eye, but in general the value is only to be known by assays. Mr. Whitney published a pamphlet, with maps descriptive of the Territory, in three languages, and distributed copies liberally. The collection was made much more interesting to the public by this means, and it attracted the attention of French capitalists to the Territory.

The principal mining in veins for gold has been in the counties of Gilpin and Clear Creek. The veins traverse granite, and are seldom over four or five feet thick. They appear on the surface by a discoloration of the soil and a spongy quartz. Considerable gold is extracted from these decomposed outcrops by sluicing. As the veins are opened and worked the decomposed ores are gradually replaced by solid sulphurets of iron and copper, which in some few cases pay for working in the raw state, but in general require smelting. The process now adopted as the best, is to smelt the ores roughly so as to obtain a cupriferous matte, which holds the gold also. This matte is then sent across the Plains to the Atlantic Coast, and shipped to Swansea for the separation of the metals. This of course entails a great expense for transportation, but it is said to be profitable and several furnaces have been erected during the past year. Some of the ores which yielded only ten or fifteen dollars per ton by stamping and pans in Colorado, yielded two hundred and three hundred dollars per ton by the methods at Swansea. Some of the matte contains thirty per cent. or more of copper, and as this metal is saved at Swansea, it alone more than pays the costs of transportation, and perhaps of separation.

AUSTRALIA.

The representation of the extensive gold regions of the Australian Continent were quite meagre and by no means worthy of the country. No organized effort appears to have been made, and the opportunity to show the nature of their ores and to make direct comparisons between them and those of other gold regions has been lost. There were a few desultory specimens of quartz, and some of them closely resembled some of the specimens in the California collection from Amador and Mariposa Counties. One specimen was interesting for the close association of gold and sulphuret of antimony, which has not been observed in California. There were several varieties of placer gold in trays and a few ingots, but there was no peculiar interest attaching to them.

A model of the celebrated "Welcome Nugget," in plaster and gilt, was shown, and was almost as good to exhibit as the original, which was worth about fifty thousand dollars. It weighed a little over two thousand two hundred ounces.

The total gold product of Victoria was very effectively shown by a tall gilded pyramid, which represented the bulk of the gold which was taken out of the mines from eighteen hundred and fifty-one to eighteen hundred and sixty-six. This pyramid was ten feet square at the base, and sixty-two feet five and one half inches high; its bulk was two thousand and eighty-one and one-half cubic feet. It represented the gross weight of thirty-six million five hundred and fourteen thousand three hundred and sixty-one ounces, or one thousand one hundred and seventeen tons, fifteen hundred-weight, two quarters and twenty-six pounds, and valued at one hundred and forty-six million fifty-seven thousand four hundred and forty-four pounds sterling. The pyramid was made in sections placed one upon another. A framework was covered with boards and these covered with stout canvas, the surface of which was studded with bits of plaster and pebbles to represent the grains and lumps of gold. The gilding gave a uniform gold surface and the effect was very good. A similar pyramid could have been sent from California at a very moderate cost.

But the meagreness of the Australian display of ores was redeemed to a great extent by the publication of valuable statistics of the yield of the placers, and the number and the production of the quartz mines. There were also valuable pamphlets and prize essays upon Australian vegetation, agricultural capabilities and the climate.

From the mineral statistics of Victoria for the year eighteen hundred and sixty-six, it appears that the number of quartz miners employed in the different districts was as follows:

Districts.	Quartz Miners.
Ballarat	2,005
Beechworth	2,941
Sandhurst	4,118
Maryborough	2,292
Castlemaine	2,648
Ararat	874
Total	14,878

There were four hundred and eighty alluvial mining engines, with an aggregate horse power of nine thousand nine hundred and eighty-one, and five hundred and ten quartz mining engines, with an aggregate of nine thousand two hundred and thirty-one horse power. The number of stamps was five thousand four hundred and thirty-seven.

The following shows the number of tons of quartz crushed (as far as the exact returns had been received) and the average yield per ton. The price paid for treating quartz varied from four shillings to one pound ten shillings per ton:

Mining Districts.	Tons Crushed.	Produce.		Yield per ton.	
		Ozs.	Dwt.	Dwt.	Grs.
Ballarat	238,503 1-2	58,157	3	4	21.0
Beechworth	130,519 11-20	118,495	19	18	3.7
Sandhurst	244,807 1-2	118,743	10	9	16.8
Maryborough	79,552 3-5	44,967	14	11	7.3
Castlemaine	124,374 1-2	85,662	3	13	18.5
Ararat	43,711	33,868	18	15	11·9
Totals	861,468 13-20	459,895	7	10	16.2

This shows an average of ten pennyweights and sixteen grains per ton, or about ten dollars. Of the total gold exported, the ratio of the gold from quartz veins to that from alluvial deposits was nearly as follows:

Where obtained.	Ounces.
From quartz veins	521,017
From alluvial deposits	958,177
Total	1,479,194

QUEENSLAND AND NOVA SCOTIA.

There were several nuggets of gold from Queensland, the heaviest weighing eighty-four ounces. The quartz veins of Nova Scotia were represented by numerous specimens, some of them quite rich in coarse gold. The quartz is remarkable for its peculiar resinous and glassy lustre, and the gold is remarkably yellow and of superior fineness.

BRAZIL.

The interesting gold region of Brazil was represented by a few specimens, arranged with the diamonds, amethystine quartz, crystals, topazes and other interesting minerals of the country, in a glass case. The principal mine now worked is the Morro Velho, belonging to the St. John d'El Rey Company of England. This is probably the most productive and profitable gold mine in the world. The net paid up capital was one hundred and twenty-eight thousand four hundred pounds, and there has been paid out in dividends seven hundred and fifty-six thousand two hundred and forty-five pounds, besides an additional amount in improvements, which carry the profits up to one million seven thousand four hundred and ninety-four pounds, or about five million dollars.

The total value of the precious metals extracted from the mine has been two millions nine hundred and two thousand four hundred and eighty pounds, and the whole amount of mineral raised has been one million seven hundred and sixty-nine thousand and fifty tons, making the average yield per ton about half an ounce troy, or about eight dollars, the gold containing considerable silver.

DISPLAY OF GOLD FROM OTHER COUNTRIES.

The gold of Canada, Chile, Austria, Japan and other regions was shown, but there was no striking peculiarity in the displays. There were some interesting specimens from Italy, and it appears that several mines are now being worked there successfully by English companies. Some beautiful and very coarse placer gold was shown from Roumania, but no information in regard to the deposits could be procured.

In Russia, the gold fields have an enormous extent along the Altai Range, from the Urals eastward to the Amoor, and even to the Pacific Coast. According to the statistics published by the Russian Government to accompany the specimens exhibited at the Exhibition, the best washings are in the district of Olekminsk, of Bargousinsk, and of Tlatooust; those of the Altai are next in order. The total value of the gold production, upon the price established by the Crown, which buys nearly all the product of the washings, is nineteen million three hundred and seven thousand one hundred and twelve roubles, about seventy-seven million two hundred and twenty-eight thousand four hundred and forty-eight francs annually. This is between fifteen and sixteen million of dollars, and it has been about the production since eighteen hundred and fifty.

A very interesting exhibition of native gold was made by Messrs. Johnson, Matthey & Co, of London, large manufacturers of platinum apparatus for the use of chemists and chemical manufacturers. This firm filled two large glass cases in the English section with samples of its various products, both raw and manufactured. One case was devoted almost exclusively to a collection of native gold, and gold in ingots, in plate and in foil, together with an imposing array of bars of silver from various parts of the world, but particularly from Nevada and Chile.

The collection of native gold contained samples from most of the gold-producing countries, and was formed chiefly of river or scale gold, and thus presented a great uniformity in its appearance. The samples were very neatly arranged in flat-topped show-bottles, and the exhibit was interesting chiefly for the number of localities represented. Most of the large ingots are only models; but having exactly the form and appearance of the originals, very few persons were aware of the fact.

SILVER AND ORES OF SILVER.

The silver ores from the region of Austin and Eastern Nevada, brought by Colonel Buel, formed the last addition to the mineral display of the United States. It was by far the most important contribution of silver ores in the Exhibition, and with the large masses of rich ore from the Poorman Lode, Idaho, and the beautiful mass of dark-colored silver ore from Blind Springs, California, it made an array of which the silver miners of the Pacific Coast may well be proud, although they did not show specimens of half of the well known lodes. The Comstock Lode was not represented in Colonel Buel's collection, but fortunately there were

a few specimens in Dr. Pigné's collection and in that sent by the writer, so that it was possible to show the character of the ores to those most interested, and to make some comparisons. There were many inquiries for specimens of the Comstock ores, and many Californians were surprised that it was not more extensively and appropriately represented. There was a great demand also for information and statistics, and the edition of the little book which Colonel Buel published upon Eastern Nevada was soon exhausted. This was prepared by Myron Angel, of Nevada, for the Committee, and was accompanied by a map showing the various mining districts around Austin and north and south of it.

A suite of specimens of the ores from Eastern Nevada, sent to the Imperial School of Mines, was assayed and yielded in silver at the rate of sixty-seven dollars to five thousand dollars per ton of silver and gold, as will be seen from the appended results. The Imperial Commission awarded a silver medal for this collection, and it will doubtless receive an appropriate notice in the official report to the French Government.

The original and the translation of the following table of results of assays are given as published and circulated at the Exposition:

EXTRAIT DES REGISTRES

DU

BUREAU D'ESSAI POUR LES SUBSTANCES MINÉRALES.

PARIS, le 1er août 1867.

ONZE MINERAIS D'ARGENT, PROVENANT D'AUSTIN-NEVADA, REMIS PAR M. GRUNER, INSPECTEUR GÉNÉRAL DES MINES.

1. HIGHBRIDGE MINE.—Cuivre gris avec cuivre sulfuré et altérations de cuivre carboné vert et bleu, mouches de blende sur quartz ferrugineux.

Argent 0|0.....4.535
Or 0|0.....0.000

2. TRANSYLVANIA MINE.—Cuivre sulfuré avec cuivre carbonaté vert et bleu ; mouches de blende et de galène cuivre gris et mispickel sur quartz ferrugineux.

Argent 0|0.....1.405
Or 0|0.....0.000

3. VANDERBILT MINE.—Sylver Peak et Red Mountain Co, étiquette Pocotillo.—Quartz imprégné de cuivre gris avec altération de cuivre carbonaté vert et bleu. Fer oxydé hydraté jaune, mouches de galène et peut-être argent sulfuré.

Argent 0|0.....2.370
Or 0|0.....0.008

4. FISHERMAN LEDGE.—Bullion Co Reveille, District.—Quartz imprégné d'altérations cuivreuses, faibles mouches de galène et de blende.

Argent 0|0.....4.545
Or 0|0.....0.0005

5. CHASE MINE.—Yankee Blade.—Roche quartzuse grise imprégné d'argent sulfuré, d'argent natif, d'argent gris, de cuivre gris avec cuivre pyriteux.

Argent 0|0.....6.250
Or 0|0.....0.00025

6. GREAT EASTERN MINE.—Argent gris, argent rouge, peut-être argent, sulfuré, cuivre pyriteux en grains cristallins très-petits, pyrite de fer, mouches de galène sur quartz.

Argent 0|0.....9.280
Or 0|0.....0.00250

7. FLORIDA MINE.—Argent gris avec argent rouge sur quartz.

Argent 0|0.....11.170
Or 0|0.....0.0005

8. TIMOKE MINE.—Argent gris avec argent rouge et cuivre gris sur quartz.

Argent 0|0.....14.100
Or 0|0..... 0.001

9. MANHATTAN MINE.—North Star Mine.—Argent rouge, argent gris avec mouches de pyrite de fer sur quartz.

Argent 0|0.....4.710
Or 0|0.....0.0005

10. DIANA MINE.—Cuivre gris avec pyrite de fer et de cuivre, mouches de galène sur quartz avec un peu de feldspath rose.

Argent 0|0.....6.930
Or 0|0.....0.000

11. FAIRMOUNT MINE.—Twin River.—Galène à facettes curvilignes, cuivre gris, mispickel, mouches de blende sur quartz.

Argent 0|0.....0.180
Or 0|0.....0.00025

L'Ingénieur en Chef des Mines
Directeur du Bureau des Essais,

L.-E. RIVOT.

EXTRACT FROM THE REGISTER

OF THE

BUREAU OF ASSAY OF MINERALS.

PARIS, August 1st, 1867.

ELEVEN SPECIMENS OF SILVER ORE COMING FROM AUSTIN, NEVADA, U. S., RECEIVED FROM MR. GRUNER, INSPECTOR-GENERAL OF THE MINES OF FRANCE.

1. HIGHBRIDGE MINE.—Gray copper with sulphuret of copper and altered blue and green carbonate of copper, speckled with blende on ferruginous quartz.

Assay of silver per ton of 2,000 lbs.....$1,709.68

2. TRANSYLVANIA MINE.—Sulphuret of copper with blue and green carbonate of copper and mispickel on ferruginous quartz.

Assay in silver per ton of 2,000 lbs.....$2,794.50

3. VANDERBILT MINE.—Silver Peak and Red Mountain.—Quartz, impregnated with gray copper, with altered green and blue, carbonate of copper, yellow hydrated oxide of iron, specks of galena and perhaps sulphuret of silver.

Assay in silver per ton of 2,000 lbs.....$687.30

4. FISHERMAN LEDGE.—Bullion Company, Reveille District.—Quartz, impregnated with altered copper, small specks of galena and blende.

Assay in silver per ton of 2,000 lbs.....$1,713.46

5. CHASE MINE.—Yankee Blade.—Gray quartz rock, impregnated with sulphuret of silver, native silver, gray silver and gray copper, with copper pyrites.

Assay in silver per ton of 2,000 lbs.....$2,356.50

6. GREAT EASTERN MINE.—Gray silver, ruby silver, perhaps sulphuret of silver, gray copper, copper pyrites in very small crystalline grains, iron pyrites, specks of galena on quartz.

Assay in silver per ton of 2,000 lbs.....$3,498.50

7. FLORIDA MINE.—Gray silver, with ruby silver and gray copper on quartz.

Assay in silver per ton of 2,000 lbs.....$4,211.09

8. TIMOKE MINE.—Gray silver, with ruby silver and gray copper on quartz.

Assay in silver per ton of 2,000 lbs.....$5,349.63

9. MANHATTAN MINE.—North Star Mine.—Ruby silver, gray silver, with specks of iron pyrites on quartz.

Assay in silver per ton of 2,000 lbs.....$1,365.90

10. DIANA MINE.—Gray copper with iron and copper pyrites, specks of galena on quartz, with a little rose-colored feldspar.

Assay in silver per ton of 2,000 lbs.....$2,612.61

11. FAIRMOUNT MINE.—Twin River.—Galena with curvelinear faces, gray copper, mispickel, specks of blende on quartz.

Assay in silver per ton of 2,000 lbs.....$67.86

Chief Engineer of Mines and
Director of Bureau of Assay,

L.-E. RIVOT.

IDAHO—THE POORMAN ORE.

The New York company which now owns and works the Poorman lode sent over in good season several very large and wonderfully rich masses of the ore. One of them weighed about two hundred pounds, and consisted in great part of red silver ore. It has occupied the top of a great pile of ores from the United States, and for a long time was hardly noticed by even experts as an object of any great consequence. It was only necessary, however, to look closely to see the massive ruby silver and crusts of chloride. The Jury awarded a gold medal to Mr. Walbridge for this display.

THE BLIND SPRING ORE.

The very fine specimen sent by Dr. Harkness and Dr. Frey, of Sacramento, attracted some attention from the mineralogists by reason of its richness in silver, and because it contains some of the compound called Partzite, and supposed to be a new mineral. It was the general opinion, however, that the mineral is not sufficiently well characterized to be regarded as a distinct species. It is probably a mixture of other minerals, and has not a constant composition.

KONSBERG SILVER MINES, NORWAY.

As regards beauty of specimens and mineralogical interest, there was nothing so fine as the exhibit made by the Norwegian Government of the products of the Konsberg mines. A glass case was filled with the most extraordinary crystallizations of native silver and of the sulphuret. This silver is remarkably white and contains a little quicksilver naturally alloyed with it. This collection was a very complete one, as regards the associate minerals and rocks, and was accompanied by several colored sections of the veins and galleries of the mine.

CHILE SILVER MINES.

There was a very important collection of the silver ores of Chile. Some specimens of the ruby silver in crystals from Chañarcillo were remarkably fine. There were also some specimens of the rare compounds of silver, such as amalgam crystals, the chloro-bromide of silver, and a new mineral (a double iodide of silver and of mercury) called *tocornalite*, by M. Domeyko, Professor in the School of Mines at Santiago, who sent a short memoir with the collection. According to this author, the silver veins of Chile, such as those of Trés Puntas, Chañarcillo, Agua Amarga, are found in an argillaceous limestone formation, often fossiliferous, and belonging to the Jurassic epoch. These mines are further from the coast than the rich copper deposits.

The exportations of silver from Chile for the last five years have averaged about thirty-three thousand and eighty-six kilogrammes, exclusive of the metal contained in the mattes of argentiferous copper and the unworked ores. The silver coinage in eighteen hundred and sixty-six amounted to nine hundred and seventy-three thousand four hundred and twenty-eight dollars, in pieces of fifty, twenty, ten and five centimes. An interesting collection of ores illustrated the process of treatment of argentiferous copper ores by fusion to obtain a rich matte for exporta-

tion. These mattes contain fifty-six per cent. of copper and two hundred and forty-one thousandths of silver. The scoriæ which result from the smelting ordinarily retain two thousandths of copper and five ten-thousandths of silver.

SILVER MINES OF FREIBERG, SAXONY.

The Freiberg mining region was well represented in the Exposition by a careful selection of the ores of the different formations, accompanied by their products. As the writer visited these mines; he is able to present some of the following details from personal observation :

There is a tradition, generally believed, that the veins of Freiberg were discovered by a teamster named Goslar, in the twelfth century. This recalls at once the recollection of the discovery of the Austin silver mines by the rider of the Pony Express, and it is singular that the ores of Austin and those of Freiberg are in some respects similar. In eighteen hundred and twenty-five, the now venerable Professor Breithaupt made a calculation which showed that in six hundred and forty years the Freiberg mines had produced eighty-two thousand quintals of silver, worth two hundred and forty million of thalers.

Freiberg is only one of the mining centres of Saxony. The ore bearing or metalliferous region is divided into four mining districts, as follows: Altenberg, thirty-one mines; Freiberg, ninety-eight; Marienberg, forty-eight; Schwarzenberg, one hundred and forty-six. This shows a total of three hundred and twenty-three mines in the four districts. Of these mines only twenty are worked by the Government; the others are explored by companies and private capital. The total number of miners in the district is set down in the Government reports as ten thousand one hundred and twenty-two, and the number of smelters or laborers at the reduction works as one thousand one hundred and seventy-five.

In the year eighteen hundred and sixty-five the amount of first class ore delivered at the Freiberg smelting works was about thirty-three thousand six hundred and fourteen tons, worth one million, seventeen thousand three hundred and five dollars (in its raw state), or thirty dollars a ton. These ores when worked gave products to the value of about two million dollars. The principal products, and in the order of their value, are silver, lead and its oxides, sulphate of copper, sulphuric acid, gold, zinc, nickel, bismuth and arsenic. The amounts are given in round numbers, on account of the difficulty in calculating the different German weights and values.

The products of the Freiberg smelting works are derived not only from the ores of Freiberg, but from those of other districts, and also from distant places. Some ores are received there from South America and Mexico; those from the latter places being chiefly antimonial ores, and sent as ballast at a small cost for freight. The whole quantity of foreign ores is, however, inconsiderable, compared with those of the region.

There are three or more groups or systems of veins, having different directions and intersections at various angles. A copy of the official map of the region shows veins running parallel with each other and in close proximity. They are regarded as separate, though usually worked under one company or administration. They are quite different from our Comstock lode, being in general quite narrow compared with it, and without such remarkably well formed selvages or clay walls. I told one

of the Professors of the costly litigation we had had in Nevada upon the question of one or more ledges, and he remarked that formerly there had been similar and protracted disputes in Freiberg, until finding it impossible to settle the question satisfactorily, the laws had been changed so as to make the claims square; in other words, they adopted the plan of square locations.

The mining laws require the finder of a vein to obtain a permit to work it from the Government, and to have it recorded in the Government office. Each claim is divided into one hundred and twenty-four shares, of which one belongs to the discoverer, one to the owner of the land, and two to the town. These four shares are unassessable, so that the whole expense of development or improvement falls upon the outside holders. Owners of stock have the option of giving up their shares to avoid the payment of an assessment. In this case the shares fall into the hands of the Mining Office, and are sold to the highest bidder, preference usually being given to the old stockholders. The "freeze out game" seems to have been practiced here for a long time, for the large and wealthy companies gradually absorb the smaller ones. Of all these mines there are only six that pay dividends regularly, while there are several that just make expenses and continue to develop without assessing. There is one mine that regularly assesses the stockholders twenty-five dollars per share quarterly. The Himmelfahrt mine and the Himmelfurst are two of the most extensive in the vicinity of Freiberg. The former paid seven hundred thalers per share last year, and the shares now command from eight thousand dollars to ten thousand dollars each; forty years ago they could have been bought for eleven cents a share. The Himmelfahrt paid six thalers a share last year. The mines are now producing better than they have for years previously. It is said on good authority that the establishments here, including the reduction works, give in the aggregate a profit of eight to ten per cent. per annum upon the investment.

The Himmelfahrt is one of the most extensive and deepest of the mines. Its shafts are just outside of the old walls of the city, and they have been carried to the depth of nearly two thousand feet. The length of the galleries is reckoned in miles, and portions of them extend under the town. They form a complete labyrinth, and many are so little frequented that a stranger might easily get lost and perish, perhaps, of starvation, before finding an exit.

It was very interesting to walk through the ancient workings, where the galleries had been cut by pick and gad alone, without the aid of gunpowder. They are very narrow, but are high, with the top roundly arched, and all very smoothly cut. They reminded me at once of the galleries in the Japanese mines, cut in a similar manner. One of these galleries led to a place where two tablets, carved out of the solid walls, bear the date of seventeen hundred and sixty-seven and inscriptions noting the fact that powder was first used in the mine near that spot, To descend to the depth of two thousand feet, and ascend, is no small journey, and exhausts a great part of a miner's strength. To avoid this the deep shafts are fitted with the well-known man machine, or *fahrkunst*, by which the trip can be accomplished with comparatively little fatigue. In this mine the man machine and pumps are operated by water wheels about thirty feet in diameter, which are placed in large chambers excavated far below the surface. The water is brought in by a gallery, and after passing over the wheels escapes by the adit. The hoisting is performed by the same power, transmitted by wire cable to

the surface. Steam is used at other shafts. The engines are generally horizontal, provided with link motion, and are connected with the bobbin shaft by gearing. The friction band operates upon the periphery of the flywheel, which is better than our system. Their bobbins and pulleys at the head of the shaft are generally of good size—not less than eight or ten feet in diameter—and are double, so that while one cage or skip is descending the other is ascending. Round iron cable is used exclusively. No person is allowed to ascend or descend in the skip or car.

Most of the veins are without gouge or selvage, and all the ore must be blasted out. I was surprised at the small size and lightness of the German drills. A California miner would hardly consent to use them after handling our octagonal steel drills.

The ores of Freiburg are taken to smelting works situated in a deep basin-like valley, upon the Mulde, where there are hundreds of furnaces in constant operation. The ores which were formerly treated by amalgamation in barrels are now treated by fire, and the silver is gradually concentrated into metallic lead, from which it is separated by Pattimon's process. Almost all the constituents of the ores are utilized. Amongst them are lead, zinc, copper, silver, gold, arsenic, cobalt, sulphur, sulphuric acid, sulphate of copper, orpiment and realgar.

There are about forty students in the Academy from the United States, including six from California, or in all about half of the total number of students.

The country rock of the Freiberg veins is a hard tough gneiss—in fact, the typical gneiss—which is evidently a metamorphosed sedimentary formation, and is in many places nearly horizontal. The veins cut across it, and are, for the most part, nearly vertical. They make very little show at the surface, for there is no heavy gangue or veinstone of quartz, as with most of our mineral veins. The outcrops are generally very rusty and red, and thus indicate at once the pyritiferous character of the ores below. The ore is generally a mixture of iron and copper pyrites, with arsenical pyrites, galena, blende, and here and there the silver sulphurets. Occasionally very beautiful crystallizations of the silver minerals are found, and the cabinet of the Mining Academy is enriched by them. It contains a magnificent collection of these ores and crystals taken from the different veins for one hundred years past. Now and then considerable quantities of native silver are found. In four years, from eighteen hundred and fifty-seven to eighteen hundred and sixty-one, eight thousand three hundred pounds of this metal were taken out of the Himmelfurst mine, most of it in large plates, one of which weighed four hundred pounds.

A mine called the Chur Prinz, a few miles from Freiberg, belongs to the Government, and is kept as a sort of experimental mine, where new inventions and processes are tried at the public expense. Two of Blake's ore breakers are used here to prepare the ore for the jigs and other concentrators. The ore passes from one breaker to the other, the last being adjusted to crush fine.

The stamping mills are very rude and do not compare favorably with ours for efficiency and economy of power. The total number of stamps about Freiberg is six hundred and fifty-six; of these five hundred and seven are dry stamps, and one hundred and forty-nine wet.

Water is raised from the deep mines, not by water power alone, but also by Cornish steam engines at some places, and by the column of water, or "water-pressure engines" in others. Some of these latter are

very perfect and interesting in their operation. Two long tunnels have been projected for the drainage of these mines. One of them is in progress. It will be about eight miles long, and will require many years yet for its completion. It is worked upon at several different points by means of shafts. The other tunnel has been surveyed and talked about, and is intended to be no less than twenty-eight miles long, but the money to construct it has not been obtained, and it is not probable that it will ever be commenced. The developments made by the other tunnel in the ground outside of the belt of the veins have not been of a nature to encourage a hope that the lower tunnel would cut or discover new veins. During eighteen hundred and sixty-five, the whole number of men employed in the tunnel was two hundred and twenty, and the costs for the year was seventy-eight thousand five hundred and ninety-nine thalers.

A few facts upon the rate of wages in Saxon mines may be interesting to California miners:

For eight hours work a miner receives about twenty cents (gold); an under superintendent thirty to thirty-seven cents, and a superintendent about four hundred dollars a year. Boys receive from ten to fifteen cents, and carpenters about the same. One tenth part of the wages is retained for a common fund devoted to the support of indigent miners.

There is a feature in a German miner's life which will seem very odd to most Californians. Every day before the men enter the mine they meet in a chapel at the mouth of the shaft and have a short religious service. Passages of Scripture and prayers are read, psalms are sung, in which they all join. After this the roll is called by the sub-superintendent, and the orders for the shift are given. The miners appear to enjoy good health, and to be contented and happy. They lead a quiet and simple life, and are full of good will towards others. This is expressed in the "*Gluckauf*," or "luck to you," with which you are greeted on coming or going.

SILVER LEAD ORES.

The largest mass of silver in the Exhibition was in the French department, and was extracted from argentiferous lead ores by one of the silver lead companies of Pontgibaud. It is just as it came from the cupel, and is nearly one yard in breadth, and is valued at twenty-seven thousand dollars. It is accompanied by interesting samples of the ores of lead, rough and dressed, and the products of the smelting and cupellation. These are all tastefully arranged in a large glass case, together with large pigs of commercial lead and samples of pipe and sheets. The following is the amount of lead and of silver in several of the ores which are treated at this establishment, in one thousand parts:

Pzaual—	
Lead	620.
Silver	2.450
Roure—	
Lead	287.50
Silver	1.087

Lagrange—	
Lead	272.50
Silver	1.087
Brousse—	
Lead	730.
Silver	3.60

The rich lead in bars contains 0.017 of silver, and the working lead 3.857.

The lead mines of Argentiere exhibited a large mass of granular galena and calcareous gangue, containing, of lead forty-three per cent.; and of silver, one hundred and forty-four grammes per one hundred kilogrammes of ore—four hundred and thirty-five grammes per one hundred kilogrammes of lead.

The following assays show the average quality of the ores:

First quality—	
Lead	45 per cent.
Silver	200 grammes per 100 kilogrammes of ore.
	444 grammes per 100 kilogrammes of lead.
Second quality—	
Lead	40 per cent.
Silver	174 grammes per 100 kilogrammes of ore.
	434 grammes per 100 kilogrammes of lead.
Third quality—	
Lead	38 per cent.
Silver	163 grammes per 100 kilogrammes of ore.
	430 grammes per 100 kilogrammes of lead.

The argentiferous lead ores of Gennamari and Ingurtosu, Sardinia, were also exhibited in the French section. The ore is in large masses and is rather fibrous in structure, but breaks with a brilliant sparkling fracture. Some specimens, however, are compact and granular.

These ores assay as follows:

Ores.	To 100 kilogrammes of ore.
a—Ores of Gennamari—	
Lead	76 to 81 kilogrammes.
Silver	50 to 66 grammes.
b—Ores of Ingurtosu—	
Lead	76 to 81 kilogrammes.
Silver	24 to 34 grammes.

The Talisker Silver Lead Company of South Australia made an interesting exhibit of the ores and of the bars of lead produced from them. Some very rich specimens of argentiferous lead ores were shown in the collection from Colorado. The veins are said to be large and numerous, and it is reported that other discoveries of rich silver ores have been made during the past Summer.

PLATINUM AND MANUFACTURES FROM IT.

Numerous masses of native platinum were shown in the Russian section from the washings on the estate of Prince Demidoff, in Siberia. One of these masses weighed thirteen pounds. The smaller nuggets were quite magnetic, and attracted iron filings like loadstone.

The most attractive display of this metal, and probably the finest ever made, was by the firm of Johnson, Matthey & Co of London, who are the most extensive and expert manufacturers of articles in platinum for the use of chemists and others. The actual value of the metals and articles manufactured by them, in two cases, was nearly $100,000. The attention was first attracted by the enormous size of the platinum boilers used for the concentration of sulphuric acid. These are in the form of stills, nearly four feet in diameter and are sufficiently capacious to concentrate eight tons of acid a day. They show many improvements over old patterns; but what is most remarkable is, that they are made without joints, soldered with gold as usual. They may be considered as formed of one piece of metal, and as specimens of autogenous soldering they are remarkably fine and interesting. The price of a still of the capacity of five tons a day is four thousand francs, and of one that can concentrate eight tons, sixty-two thousand five hundred francs.

There was a great variety of smaller platinum vessels, such as evaporating dishes, crucibles, small stills for fluoric acid, siphons, tubes and alembics, all of them showing great skill in forging and working the metal.

Alongside of these vessels there were several large ingots of the metal chemically pure, and intended for the fabrication of sulphuric acid stills.

These ingots are about as large as two bricks placed side by side, and they were melted under the oxy-hydrogen blow-pipe, according to the method of St. Claire Deville and Debray. A few irregular projections on these masses show how perfectly fluid the metal was—so much so as to penetrate into every small cavity of the mould. There were but few of the many persons that looked upon those triumphs of science that knew that even a small wire of the same metal cannot be melted in the hottest forge fire. Each of these ingots is valued at thirteen hundred francs. In addition to these ingots there was a model of the great ingot melted for the Exhibition of eighteen hundred and sixty-two. This ingot was the largest ever made and weighed one hundred kilogrammes, and was valued at eighty-five thousand francs. It is not probable that another ingot of equal size will be produced. The model was therefore of peculiar interest and value.

APPARATUS FOR ASSAYERS.

Among the great variety of objects, there was an apparatus in platina for facilitating gold assays. This, if not already in use by our assayers, should interest some of our establishments in San Francisco, for it is

claimed to be a great improvement upon old methods and to give more exact results.

It consists of two shallow kettles of platinum about a foot across the top, set in holes like those of the top of a stove, so that heat from a gas lamp or stove can be applied below. The nitric acid for dissolving the silver out of the assays is placed in the kettles. A frame of platina, made to fit the kettles, is divided into two hundred or more little partitions, into each of which a small platinum cup is placed. These cups are not larger than a child's thimble, and are movable. The bottom of each is pierced with fine slits at right angles, so that the acid can enter when they are lowered with the frame into the kettle, and so that it may drain out when the frame is raised. It will be seen that the number of assays is limited only by the number of the cups. No glass is used. By means of this apparatus the pouring off of acid and the separate washing of each assay is avoided. It has been in use for five years in the laboratory of the firm with complete success. The whole apparatus with two kettles is about two feet long and thirteen inches wide. A porcelain hood covers the kettles and discharges the distilled acid into a vessel at one side.

MAGNESIUM.

The same firm exhibited an obelisk of pure magnesium, weighing five kilogrammes, or eleven pounds. The metal was shown, also, in large quantities in the shape of foil for batteries, in ribbons and wires of various sizes. In another part of the Exposition a little apparatus was shown containing a coil of magnesium wire which may be fed out regularly as fast as it burns. The whole is not larger than a watch, and may be carried in the pocket in readiness for the production of a light almost equal to that of the sun. This would be very useful in caves and in the examination of the dark galleries and chambers of mines, but the direct light should of course be carefully kept from the eye.

IRIDIUM, OSMIUM AND OTHER RARE METALS.

The exhibition of the rare metals was the most complete ever witnessed, and rejoiced the heart of a chemist, who perhaps had never before seen more than a grain or two of some which were there shown in massive ingots. A bar of iridium, for example, two or three inches long! This was the second which had ever been melted and cast, and was made up of small grains not much larger than the tips of a gold pen. This metal is so hard that diamond dust must be used to cut it; and the question here arises whether in this solid form we may not use it for tools by which to cut hardened steel, and turn and fashion the hardest rocks.

The bar of osmium which was near by—a metal generally found in nature in close association with iridium—presented a totally different appearance, for it looked like a mass of coke.

Ruthenium is the only one of these rare elements which was not shown in great quantity. There were a few grains as large as peas. But any disappointment in this case was more than compensated by the sight of a goodly quantity of boron and silicon, and of a remarkable series of the various metals cast in cylinders of equal diameter, but each specimen having the same weight (one kilogramme, or about two pounds each). The result was that the cylinders had very unequal lengths, and thus exhibited in a very striking manner the difference in the specific weights of the metals. The series contained gold, silver, platinum, iridium, rhodium,

palladium, lead, bismuth, copper, cadmium, cobalt, nickel, iron, antimony, zinc, magnesium, aluminum, thallium, sodium, potassium, osmium (not melted) and mercury.

Each cylinder was about one inch in diameter. Quicksilver, which was in a melted state at our ordinary temperatures, and the metals which oxidize rapidly in the air, were confined in glass. The other specimens were just as they came from the mould.

The platinum cylinder was about four inches long; the quicksilver about seven inches, and the others elongated by a very regular gradation up to aluminum, which towered two feet above the preceding, and was in its turn overtopped by the magnesium cylinder nearly four feet long. Thus, at one end of the series, a bar of metal four feet long would just counterpoise the bar of platinum, only seven inches long, at the other end.

In the collection sent from the metallurgical works of Freiberg, Saxony, there was an ingot of the new metal, indium—a great novelty—which was prepared by Professor Richter at great cost.

CHAPTER V.

USEFUL MINERALS, MATERIALS FOR PORCELAIN, ORNAMENTAL STONES AND GEMS.

EMERY.

The Chester Iron Company of Massachusetts sent a splendid illustrative series of the emery and the accompanying minerals from the recently-discovered bed in Chester, Massachusetts. This, it will be remembered, was discovered by Dr. Jackson, of Boston, in some samples of magnetic iron ores sent to him for assay. This was one of the most striking examples of the direct practical value of mineralogy as a science. The mineralogical association of emery had been previously studied with much care by Dr. J. Lawrence Smith, and he had observed that the foliated white mineral which he called *emerylite* was an almost constant companion of emery or corundum. The recognition of this mineral in the Chester specimens caused Dr. Jackson to indicate the existence of emery at that locality to the company, and the result was the opening of a deposit of great size and of superior quality. The Jury recognized this discovery by awarding a medal to Dr. Jackson, although he was not a participator in the display.

GRAPHITE.

The number of specimens of graphite from various parts of the world was very great, and was exceeded only by the display of the various articles into which this mineral enters as the chief constituent—such as crucibles, melting pots, pans, furnace linings, etc.

The great attractive and brilliant display of the raw material was made by M. Alibert, who sent a large quantity of the mineral in its raw state from Mount Batougal, near Irkoutsk, in Siberia. This graphite is remarkable for its density, freedom from grit, for its blackness and for a peculiar fibrous structure which shows upon the surface of the block like the grain of split wood. This structure has already been noted by the celebrated Russian mineralogist, General Kokscharof, in his Mineralogy of Russia. Most of the masses have a prismatic form,

and are from one to three feet long and are only a few inches in diameter, looking as if they had been split out like wood. It is very dense and homogeneous, and can be sawed and cut into any desired shape, and will bear cutting into long pencil-like masses with very sharp and firm points, and it is therefore well adapted for pencils, for which it is beginning to be largely used. There were some specimens which exhibit a peculiar pisolitic or nodular structure, and others which resemble the fibrous form of amianthus or satin-spar. It appears to be found in highly metamorphosed hornblendic rocks.

GRAPHITE IN BOHEMIA.

A very important exhibit of graphite in its raw and prepared state was made by the proprietors of deposits in Bohemia, which annually furnish large quantities of a very superior article for pencils, steel manufacture, the galvanoplastic art, and for various other purposes.

Mr. Victor Norback, who has made a special study of the industry of graphite, and has long been engaged in it, has kindly given me much information, which is presented in the following summary:

The principal localities are in Southern Bohemia, near Budweis. The graphite occurs there in great quantities, inclosed in gneiss and granite, together with limestone, which last is a constant associate. The graphite is in shistose layers, which vary from one inch to ten or twenty feet in width. The finest qualities are found in the middle, and are not over six inches thick. The different layers of graphite are quite distinct and parallel, and five or more are recognized.

These deposits have been worked for sixty years, and it is said that the manufacture of lead pencils would not have reached the present degree of perfection without the graphite of these mines. The pencil-makers of Bavaria, and the celebrated establishments of Faber and of Rehback use this graphite exclusively.

The clean masses of this Bohemian graphite have the following composition:

Ingredients.	Per cent.
Carbon	72.40
Oxide of iron, limestone, magnesia, alkalies, sulphur and water	17.60

The finest portions give over eighty per cent. carbon. At the beginning of this century the production was not important, but it has been steadily and rapidly increasing, as the following figures show. The production was, at different periods, as follows:

Years.	Cwts.
1823	103
1833	14,594
1843	16,000
1853	24,970
1863	83,778

The following table shows the amount produced (in hundred weights), of different qualities, for four years, from eighteen hundred and fifty-seven to eighteen hundred and sixty, inclusive:

Location and Company.	1857.	1858.	1859.	1860.	Quality.
Mine of the Duke of Schwartzenberg, in Schwartzenbach	10,920	9,681	7,758	10,374	I
	3,610	1,311	7,051	4,484	II
	17,843	23,825	31,147	21,683	III
Mines of Eggert & Company, in Mugrau	376	620	292	18	I
	1,220	951	633	708	II
	1,994	2,164	717	2,381	III
Mines of the peasants, Mugrau	931	792	814	708	I
	880	728	1,253	1,292	II
	955	844	1,631	1,809	III
Stuben mine	35	.....	.....	.....	III
Menzel and Barthol, Stuben	.....	160	200	950	III
Krauman	20	80	.....	.....	III
Anton Hofbauer, in Wettern	.....	.....	.....	25	III
Bistel & Company, in Krauman	.....	.....	.....	2,400	III
Totals	38,784	41,156	51,496	46,832	

The value of the total production at the present time is estimated at two hundred and fifty thousand dollars annually. The establishment of Krupp, at Essen, consumes twenty thousand hundred-weight annually. The mines of the Duke of Schwartzenberg are now of great extent. They produced in eighteen hundred and sixty-six:

Quality.	Austrian cwts.
First	10,000
Second	4,000
Third	60,000
Refined (washed)	36,000
Total	110,000

There are four steam engines, with an aggregate of one hundred and twenty-two-horse power, and two hundred and fifty men are employed.

GRAPHITE OF TUOLUMNE, CALIFORNIA.

The samples of California graphite compare favorably with those of the celebrated Bohemian deposits, and will no doubt be found equally valuable for similar purposes. I was able to make a direct comparison of the two, with the assistance of Mr. Norback. This is one example of the advantages derived from sending a collection of California minerals to the Exposition.

GRAPHITE OF CANADA AND OTHER LOCALITIES.

Large masses of graphite were sent from Canada, together with the washed powder, and some solid masses cut into cubes and other forms. These were homogeneous, but the graphite appears to be much more crystalline and foliated than the graphite from the localities previously noticed. It occurs in Buckingham, in Lawrentian rocks. The graphite from Ceylon also shows a decidedly foliated crystalline structure. It is largely used in England and in the United States in the manufacture of crucibles. The principal exhibitors of plumbago crucibles and similar objects, were: The Patent Plumbago Crucible Company, under Morgan's patent, Battersea Works, London, which received a silver medal. Some of their pots were three feet high. Boulton & Company of London exhibited a black lead pot five feet high. Becket & Sons, of London and Hull, showed a quantity of plumbago in large cakes formed of the purified and compressed mineral.

The celebrated Cumberland plumbago was exhibited in the form of pencils made in the building by some of Mr. B. S. Cohen's experienced English workmen. Mr. Cohen claims "to have perfected a process by which the powder and fragments of the Borrowdale lead (hitherto laid aside as almost useless), after being pulverized, are consolidated and brought to a uniform consistency and so formed into slips of the exact size and degree required for each pencil, the lead retaining in its improved form all the valuable qualities which characterize fine Cumberland plumbago." The Six H, engineers' pencils, are excellent.

CRYOLITE.

A mass of this mineral three feet long and two feet thick, from Ivigtout, Greenland, was exhibited by the Greenland Cryolite Mining Company. This mineral is now largely used as a source of sodium and its compounds, and nearly twenty thousand tons were shipped in eighteen hundred and sixty-six. It was discovered in Greenland by Giesecke toward the end of the last century. In eighteen hundred and fifty Professor Thomson, of Copenhagen, discovered the decomposability of cryolite by lime, upon which all the manufacture of cryolite soda depends. This was patented in eighteen hundred and fifty-three. The first vessel was sent to Greenland for cryolite in eighteen hundred and fifty-six, and the first manufactory of cryolite soda was established in Denmark in eighteen hundred and fifty-eight. One was established in Germany in eighteen hundred and sixty, and was followed by the erection of works in the United States in eighteen hundred and sixty-five. A company to work the mines was formed in eighteen hundred and sixty-five, with a capital of five hundred thousand rix dollars, under the direction of Professor Julius Thomson and S. W. Isberg.

This history, in brief, affords another example of the direct practical

value of mineralogical science. It shows what extended industrial results may follow from the discovery of an apparently unimportant mineral. The following shows the extent of the exportation of cryolite up to the year eighteen hundred and sixty-seven:

Year.	Number of vessels.	Annual exports. Tons.
1856	1	343
1857	1	800
1858	4	2,359
1859	5	2,788
1860	7	4,821
1861	18	7,639
1862	24	11,046
1863	10	5,498
1864	9	4,261
1865	25	19,892
1866	23	19,853
Totals	127	79,300

The duties paid to the Government amounted to four hundred and seventy-five thousand five hundred and fifty-nine francs. Five and a half cubic feet are reckoned to each ton.

ORES OF POTASH—STASSFURT PRODUCTS.

The discovery of extensive mineral deposits of soluble salts of potash has led to a complete revolution in their production and value. It has been found that the salt beds at Stassfurt, on the line between Prussia and Anhalt, are accompanied by extensive deposits of chlorides of potassium, sulphate of potash and magnesia, boracic acid and other compounds—all of considerable commercial value. Borings have been carried to a depth of twelve hundred feet without passing through these deposits, and their extent is yet unknown, but they are regarded as practically inexhaustible. The salt is mined in large quantities, and large pillars are left to support the roof; only about three quarters of the mass is removed. This salt is filled with thin sheets of anhydrite in wave-like layers. The potash salts are found above the salt with a layer of boracite (a borate of magnesia) between them. The mineral carnallite, a double chloride of potassium and magnesium, has a red color and is used chiefly for the preparation of potash. It is now exported in large quantities to the United States for the manufacture of saltpetre by the decomposition of nitrate of soda. As in California we readily obtain nitrate of soda from South America, this manufacture may perhaps be carried on to advantage in San Francisco, and our chemical and powder manufactories may profit by this suggestion. In view of the great importance of this potash mineral, an attempt has been made to have it placed upon the list of articles to be admitted to the United States free of duty. Its use in Europe has already checked the exportation of potash from the United States.

One of the most important results is the employment of potash compounds, especially the sulphate, as fertilizers, and there are already extensive establishments for their manufacture. The discovery is especially valuable to the beet growers, and it is said to have revived this languishing industry. Ziervogel & Company, at Stassfurt, advertise fertilizing salts at the following prices per one hundred kilogrammes (two hundred and twenty pounds), delivered at the railway, exclusive of cost of packing:

Article.	Per cent.	Price, francs.
Sulphate of potash, crude	18—20	3.75
Double sulphate of potash and magnesia	30—33	6.25
Sulphate of potash	55—60	18.75
Sulphate of potash, refined	80—85	30.00
Carbonate of magnesia, for legumes		5.00
Sulphate of magnesia, crude		3.75

All these manure salts are well dried and ground and can be transported in sacks.

Another large establishment at Cologne, Vorster & Grüneberg, advertise similar compounds at the same prices.

The cost of transportation from Stassfurt to Havre for five thousand kilogrammes is about four francs for each one hundred kilogrammes. Cost of sacking, one franc twenty-five centimes per one hundred kilogrammes.

BORAX.

There was no display of borax at all comparable in interest with that made by the California Borax Company, in the two collections sent on. (Vide Catalogue.) The crude native crystals, as extracted from the mud of the lake, are remarkable for their great size. Several of those shown were from three to five inches long and from one to three inches thick, and they were regarded with much interest by mineralogists.

PORCELAIN AND THE MATERIALS FOR ITS MANUFACTURE.

It is impossible to describe the variety and beauty of the porcelains of Sevres and Limoges, of England and of Prussia. Those of Sevres occupied a large space in a kind of hall or saloon, the walls of which were decorated by the inimitable Gobelin tapestries. Minton & Co., of Stoke-upon-Trent, made a great display of their superior manufactures, among which may be noted particularly their *faiences* of original and artistic patterns; their large vases for plants; ornamented dishes for the table, and their tiles in great variety. The beautiful productions of the Wedgwoods were also shown, in the form of vases and tablets, with their exquisite bas reliefs, which last are now much used for the decoration of furniture. The collection of Dresden China was particularly fine. One vase measured over six feet in height and was accompanied by candelabra also six feet high.

The displays of French *faience* were extremely interesting. The prevailing infatuation for specimens of the old enamelled wares of the

sixteenth century has excited manufacturers to produce imitations of the curious productions of Bernard Palissy, of Lisieux, and of Rouen and Nevers. These manufacturers, most of them from Haute-Vienne, made a collective display. The display from Creil and Montereau may also be cited. Artistic *faience*, however, has its centre in Paris and its environs. The great centres of the manufacture of porcelain in France are Limoges, where there are more than thirty white China works, Berry and Paris and its environs, including Sevres and Champagne. A large business is carried on in Paris in the decoration of porcelain, and one thousand three hundred and sixty-two men and four hundred and fifty-eight women are occupied in this way alone. Paris is regarded as the great centre of the porcelain and *faience* trade, and Limoges is next in importance. The value of the annual production of fine *faience* in France is estimated at ten million francs, and that of porcelain at twenty million francs.

Clay for making pottery is found in almost every part of France. The kaolins of St. Grieix, near Limoges, are the types of the best clays for the manufacture of China, but the kaolins of the Pyrenees, the Cher and the Allier are competing with them, and are largely used at Berry.

It is observed by the Committee of Admission of Class XVII that steam power has been successfully substituted to a great extent for hand labor in the making of *faience*, but not in the manufacture of porcelain, for the softening caused by the high temperature required for the baking deforms pieces made in any other way than by hand. The hope is expressed, however, that machinery may yet be employed with success in preparing and shaping the material. Workmen are almost always paid by the piece, and owing to the tenderness of the material, which prevents its being moved about, it is necessary for them to work in the factories.

The improvements in the ceramic art in France during the past twelve years are enumerated by Salvetat and Dommartin as follows:

"*First*—The increasing use of terra cotta in the decoration of public and private edifices.

"*Second*—The almost complete renewing of the plant of the *faience* potteries, so that good organization, from being an exception, has become the rule.

"*Third*—The substitution of coal for wood in the baking of porcelain, and the consequent reduction in the cost of the process.

"*Fourth*—The improvement introduced into the art of decoration through the chromolithographic process."

Among the many exhibitions of materials for the manufacture of porcelain, the following may be cited. An excellent kaolin is found in Brittany, and contains fifty-three per cent. of useful earth, of which the following is an analysis:

Component parts.	Analysis.	A
Water, by ignition	12.50	13.10
Silica	48.00	48.00
Alumina	37.36	37.00
Oxide of iron	00.75	2.50
Lime	00.15	
Magnesia	00.48	
Alkalies	00.76	
Totals	100.00	100.60

The second column of figures (A) represents the normal composition of the kaolin of St. Gricix, which is reputed to be the best kaolin known. A mixture of this kaolin of Brittany as follows:

Brittany kaolin clay	76
Residue of the same, crushed	20
Chalk of Bongival	6

gave a paste which, in baking, gave a good white and translucent body.

A sample of feldspar in the Swedish section was shown by B. R. Geyers, of Stockholm, together with a display of the porcelain ware made out of it. It is an orthoclase, and is sold at the rate of thirty-five francs per one thousand kilogrammes—about seven dollars per ton, crude. It contains twelve per cent. of potash and three per cent. of soda.

Another exhibit from Sweden, from the quarries of De Heidenstam, near Stockholm, consisted of both potash and soda feldspars. It is delivered in quantity at Havre for sixty-five francs; at Rouen for seventy francs, and at Limoges for one hundred francs per one thousand kilogrammes.

TERRA COTTA.

Terra cotta is coming into extensive use for architectural decoration. A great display of this material was made at the Exposition, not only in the form of ornaments for buildings, but in vases, columns and monumental figures. The beautiful twisted columns of the boiler-house in the Park were made of terra cotta, and were justly much admired. In London, the South Kensington Museum, and other public buildings, are decorated with terra cotta ornaments. It is used also at Berlin for the new Chemical College, and for the Cathedral.

As the materials for this manufacture are abundant and cheap in California, and as the climate is especially favorable, terra cotta should be extensively used. Some very fine specimens of this manufacture were shown at one of the Fairs of the Mechanics' Institute a few years ago.

MICA.

S. H. Randall, of New York, exhibited specimens of mica (isinglass), feldspar for porcelain manufacture, beryls and quartz. The sheets of

mica were very broad and colorless, and far superior to any other shown. The mineral is used largely for transparent doors for stoves and furnaces.

ORNAMENTAL AND PRECIOUS STONES.

There was a very large display of ornamental and of precious stones, either in the rough or cut and polished. Among the ornamental stones we include marbles, serpentine, granite and porphyry, which were shown in columns, vases or tablets beautifully polished; and jasper, onyx, malachite and lapis lazuli, which are worked into smaller objects. In these last named stones the collection from Russia was particularly rich. One of the most conspicuous objects was an elliptical vase, about six feet high, sculptured at the Imperial establishment of Ekaterinberg, out of a compact gray jasper from Kalkhansk. The shaft supporting the basin was ornamented by an entwined vine branch, with leaves and fruit exquisitely chiselled in high relief and polished.

Two magnificent candelabra, with pedestals of rhodonite, were shown, from the same establishment. These pedestals were over eight feet high and were nearly two feet broad at the base, but are probably formed of several pieces united. The rhodonite appears to occur in large homogeneous masses, and to be extensively employed for ornamental purposes. It takes a high polish and has a pleasing rose-red color, slightly mottled with black. The pedestals are beautifully formed, and the numerous arms for sustaining its candles are of metal elaborately chased and gilt.

Jean Stebakoff, of Ekaterinberg, exhibited a great variety of beautiful paper weights, made of polished slabs of jasper, malachite or lapis lazuli, surmounted by groups of flowers or bunches of fruits in their natural colors, all cut out of various high-colored ornamental and precious stones. Similar ornaments adorned the lapis lazuli panels of the magnificent cabinets presented by the Emperor of Russia to the Empress Eugenie.

The Government establishment at Tiflis, Caucasus, sent numerous ornamental objects fashioned from a kind of onyx—marble similar to the beautiful stalagmite marbles of Mexico and of Algeria; also a variety of smaller objects, in a peculiar chatoyant obsidian. The marble onyx of Algeria was largely shown in the collection sent from that country, and it is now extensively used in Europe for ornamentation either in a variety of small objects of art, such as pedestals, inkstands, paper weights, or inlaid as borders in marble slabs for tables.

The Aberdeen granite, which has a pleasing red color, was shown in large columns beautifully polished. It is coming into extensive use in England for ornamenting public and private buildings, and is deservedly much admired. The two polished columns at the entrance of the Pacific Mail Steamship Company's office in New York are formed of this stone.

Among the marbles, the mantel made of the Suisun marble of California deserves particular mention for the unique beauty of the material. It was shown from the establishment of J. Shuster, Brooklyn, New York, together with mantels of the same pattern made out of Tennessee marble and the white statuary marble of Vermont. The California marble was much admired by connoisseurs. Specimens of other marbles from California were shown in the collection made by Dr. Pigné.

There were some beautiful vases and slabs of polished porphyry from Norway, and a very interesting suite of the marbles of Italy, in blocks

about one foot square. The verd antique marbles (or serpentines) of that country were shown by a series of sixty specimens, each one highly finished, and differing, in either texture or color, from the others.

The wealth of the Russian Empire in precious stones was illustrated by a series of magnificent cut gems of the country, sent from the Imperial cabinet. This series contained amethysts, sapphires, emeralds, aqua marines, beryls, phenacites, white topaz, rubellites, tourmalines, sphene and chrysoberyl, all of them of unusual size and brilliancy. Some of the phenacites, which had a brown color when first shown, became bleached and colorless after exposure to the light.

The costly displays of jewellery by the leading British and Continental jewellers contained a great variety of precious stones, remarkable for their size and beauty. Hancock & Co. of London exhibited a sapphire of fine color, one and a half inches long and three quarters of an inch wide. M. Melléno exhibited a number of very large sapphires, and one of them weighed four hundred carats.

DIAMONDS.

In addition to the great number of large and well selected and matched diamonds mounted in various ways for personal adornment, some of the exhibitors added greatly to the interest of their displays, and gave them an additional scientific value, by showing the gem in its various colors; thus, for example, the following different colors were shown by a suite of nine large stones in the case of Hancock & Co.: Dark green; light green, like chrysolite; topaz yellow; hyacinth red; pink, like pink topaz; cinnamon-brown; bluish black, and black with a lavender shade. A peculiar steel-like and graphitic lustre of the gem was well shown in a tiara and necklace, formed of about forty stones, varying from one fourth of an inch to five eighths of an inch in diameter, but not, however, wholly free from flaws.

The interesting art of cutting and polishing diamonds was exhibited by M. Coster of Amsterdam, in a building erected for the purpose in the Park. A separate steam engine was erected in this building, and several of M. Coster's workmen were constantly engaged there in all the operations required to prepare the rough jems for jewellers. All the processes of scraping, cleaning, facetting and polishing were witnessed daily by hundreds or thousands of persons. The exhibit had also a very great scientific interest, inasmuch as the rough stones from the principal diamond-producing localities were shown in all their varieties of crystalline form and color, together with the minerals and washed pebbles usually found with them in the deposits. In the suite of diamonds of different colors there were several remarkable stones. One of them weighing twenty-nine carats (about ninety-two grains), a pear-shaped brilliant, about three quarters of an inch long, has the property of acquiring a rose-pink color, like that of a rose spinel on being strongly heated. This color is retained in the dark after cooling, but if the diamond is exposed to the light the color soon vanishes. This experiment has been repeatedly performed with like results. Another stone, half an inch or more in diameter, having a beautiful bluish black color by reflected light, appeared perfectly opaque when held between the eye and the light, owing, probably, to the total reflection of the light from the facets of the stone.

The collection contained masses of the crude black variety of diamond known as "carbon" (valuable for its powder), which are sometimes two

inches in diameter. Another variety, translucent, and apparently a compound crystallization, and of no value as a gem except for its powder, is found with the diamonds of Rio and is known as the "boast."

The rolled and water-worn pebbles found with the diamond consist chiefly of the heavy minerals, such as magnetite, chromite, ilmenite, sutile, tin-stone and other mineral species very similar to the coarse, heavy, black sand obtained in sluices by gold washers when they "clean up." All these minerals are evidently derived from the rocks eroded by the streams and concentrated in their beds, without having any special connection with the diamond or its matrix.

The conglomerate called *cascalho*, which was shown in all its varieties, evidently corresponds in its origin to the "cement" of gold miners. It consists merely of the water-worn pebbles and heavy minerals which accompany the diamonds in the streams, cemented together at and near the bed-rock by the infiltration of silicious, calcareous or ferruginous waters. These masses of *cascalho*, or diamond cement, contained diamonds cemented in the midst of the pebbles.

This cement is found in large quantities and only a portion of it is broken up by hand. There is little doubt that with machinery it could be so broken that many of the diamonds could be liberated without injury. In gold districts more or less gold is found in the deposits and in the cement with the diamonds.

The yearly importation of rough diamonds from eighteen hundred and sixty-two to eighteen hundred and sixty-six has averaged one hundred and seventy-six thousand carats, or nearly one thousand pounds troy.

OPALS, TURQUOISE, BERYL.

Some remarkably large opals were shown by Emil Goldschmidt, of Lower Austria. The largest one, oval in form and about two and a half inches long and an inch wide, was valued at seventy-five thousand francs. A second, of triangular shape and about one and one half inches across the face, was valued at fifty thousand francs, and the third, an ellipsoidal specimen, one and one half inches long and three-quarters of an inch in diameter, at thirty thousand francs. The amygdaloidal rock in which the gem is found was also shown.

A fine series of turquoise specimens, in the rough and cut, was shown by Petiteau, of Paris. Amongst the cut stones there were several of good color as large as pigeons' eggs.

One of the ornaments of a massive piece of ornamental work for the Emperor's saloon at the Hotel de Ville consisted of a bust of his Majesty, about one third life size, cut out of a single aquamarine of good color and free of flaws. It is supported upon a pedestal of bloodstone, and figures upon each side, representing peace and war, are cut out of smoky crystal, and are draped with silver.

Many very large and transparent crystals of quartz were sent from Japan, Province of Kei, where it occurs in abundance and is wrought into many ornamental objects besides the large crystal balls. An optical examination of some of these crystals by M. Des Cloizeaux showed that, in common with quartz from most other localities, the internal arrangement of the particles is so complex that plates giving a uniform tint in polarized light cannot be obtained.

A large mass of nephrite (jade), and highly polished, was sent from Siberia by M. Alibert. It was about two feet long, and weighed one

thousand pounds. This stone, which is so much prized for ornaments in China, is beginning to be used in Paris for the same purposes. Lapis lazuli, polished jaspers, porphyries, malachite, and other highly colored stones, are now used to a considerable extent for panels and ornaments upon choice pieces of furniture.

CHAPTER VI.

CIVIL ENGINEERING—SUEZ CANAL—BÉTON—ASPHALT AND BITUMEN—ASPHALT PAVEMENTS.

MODELS OF PUBLIC WORKS.

To civil engineers the exhibition of models of the most important public works of France and other countries was exceedingly interesting. The models in the French section were singularly complete, and on such a large scale that the minute details of construction could be clearly seen. In fact, it is better to study the construction of the works by the models than to examine the works themselves, for in general the models are so made that they show the interior as well as exterior details, from the foundation stones up. For all sub-aqueous structures the models are of course preferable. The scale is generally one twenty-fifth of full size, but varies from one tenth to one fiftieth.

In the Spanish section there was a sectional model of the great breakwater of Tarragona. This work, when finished, will be about fifteen hundred yards long, and one hundred yards wide at the top and three hundred yards at the base. Enormous blocks of rock are first thrown down, and interspaces are filled with smaller fragments. A layer of concrete is then laid, and thus forms the foundation for the pier. It will be seen that this construction is similar to that adopted by the Harbor Commissioners of San Francisco for the harbor wall.

SUEZ CANAL.

The progress of the great Suez Canal was fully illustrated in a separate building in the Park by a large model, a panorama, photographs and miscellaneous collections. The model of the Isthmus was a complete miniature representation of the country, with all its elevations and depressions, on a scale of one to five hundred thousand. But the canal and the elevations were somewhat exaggerated, the canal being as six to

one, and the heights as sixty to one. The distance between the Mediterranean and the Red Sea is about seventy-five miles, but the length of the canal will be about one hundred miles. Sixty-three miles of the distance is either at or below the sea level, and the remainder of the route requires cuttings of no very great depth, and in sand or earth. Those portions of the route below the sea level are where the canal enters a great interior basin, which it is believed was at no very distant period occupied by the water of the Red Sea. The completion of the canal from the Red Sea to this basin will allow the waters to enter and fill the basin. It is computed that it will hold nine hundred millions of cubic metres of water. At present it is occupied by shallow lakes of bitter water, and by extensive beds of salt, covered in places by a soft, marshy deposit, upon which it is very dangerous to venture. The region, in fact, is very similar to some of the old lake basins in Nevada during the rainy season.

The canal is to have a breadth of one hundred metres at the water line, and a depth of eight metres. The slope, or batter, of the sides varies somewhat in different portions of the route, according to the nature of the ground. It is nowhere less than two horizontal to one vertical.

The beach of the Mediterranean, for a long distance from the mouth of the canal, has a very gentle slope, and it was necessary to construct an artificial harbor or port, by the aid of long jetties or breakwaters. The place selected is known as Port Said. Two breakwater piers have been built out into the sea; that on the west side is about three thousand one hundred metres long, and that on the other side about one thousand six hundred metres. Their shore ends are one thousand four hundred metres apart, and as they extend seaward they converge to within seven hundred metres, and one projects somewhat beyond the end of the other. The space included between these two great arms is sufficient to accommodate fleets of hundreds of vessels, and they can lie there in safety while waiting their turns for the passage of the Isthmus. This artificial harbor will be dredged out to a depth of thirty feet. The jetties are about seventeen feet wide on the top, and they rise about seven feet above the average level of the Mediterranean. The talus slopes at an angle of forty-five degrees.

For the construction of these enormous piers it was at first proposed to use stones obtained from a quarry beyond Alexandria, but it was found that it took a long time to obtain them, and the expenses of transportation were great. This induced the company to enter into a contract with Messrs. Dussaud Brothers, to make artificial blocks of stone out of lime and the beach sand—a method which this firm had successfully employed at Marseilles, Cherbourg and d'Alger.

These artificial blocks are made by mixing the beach sand with Theil hydraulic lime in the proportion of three hundred and twenty-five kilogrammes of lime in dry powder, with one cubic metre of sand. The mixture is allowed to set and dry in the moulds, and is then exposed for two months to the sun and air, which hardens it into solid stones sufficiently firm to permit them to be placed; and the hardening continues below the water. Each of these blocks weighs twenty-five thousand kilogrammes. They are moved and placed, by the aid of steam cranes, with as much care and precision as a mason places a brick in a wall. The interspaces are filled with small stones, and under the action of the sea the whole soon becomes a compact and solid mass. The total cubical

contents of these piers will be nearly two hundred and fifty thousand metres.*

PROGRESS OF PUBLIC WORKS IN FRANCE.

It appears by the report of the Baron Baude, member of the Committee of Admission of Class Sixty-five, that nine thousand kilometres of railway were built in France in eighteen hundred and sixty-six, and that "the works in ports, for the lighting and erection of beacons on the coasts, for the salubrity of towns, the sewers, and the distribution of water, have received a proportionate impulse, and that the greater part of the large towns of France have been completely transformed by their application. The Committee also points out, among the principal technical improvements realized since eighteen hundred and fifty-five:

"*First*—The progress made in the trades of hydraulic lime, cements, artificial stones, potteries, slate and asphalts, and in that of hammered metal applied to the preservation and decoration of roofs.

"*Second*—The increase of the use of metal structures, which are more and more appreciated every day.

"*Third*—The increase in the number of machines employed in working wood for joiners and other work.

"*Fourth*—The constantly increasing application of compressed air in places deep and difficult of access.

"*Fifth*—The ingenious methods of lifting heavy bridges, viaducts and other metallic works.

"*Sixth*—The new system of movable dams.

"*Seventh*—The recently invented and powerful dredging apparatus.

"*Eighth*—The application of electricity to light-houses, and the new combinations made with a view to assist navigation—amongst which may be reckoned the creation of a system of coast semaphores."

We may here mention, in addition, the very great changes that are making in the City of Paris by opening new and broad avenues through the most crowded portions, the erection of new and superior buildings, and the construction of a new trunk sewer at a considerable depth below the surface to convey the sewerage of the city to a point upon the Seine several miles below. This work is prosecuted by means of shafts sunk at intervals, in the same way that drain tunnels are made for mines.

CEMENTS, BÉTON.

A French cement company of Boulogne-sur-Mer made a very interesting exhibition of French "Portland cement," for which they received a gold medal. The extraordinary strength of this cement was shown by means of blocks cut into the form of the letter I, the projections at the top and bottom serving to hold iron clamps by which weighted platforms are attached to show the strain which the various mixtures of cement and sand or pebbles will bear. A block of this shape, one and a half inches square in the centre and made of a mixture of four volumes of sand and one of cement, sustained a weight of nine hundred kilogrammes (about two thousand pounds). Another block four inches square, composed of two volumes of sand and one volume of cement, sustained a

* For further details reference may be made to "Exposition de la Compagnie Universelle du Canal Maritime de Suez." 8vo. Paris, 1867. Exposition Universelle.

weight of one thousand two hundred kilogrammes. The "sand" mixed with this is as coarse as beans and peas

Another and very striking mode of testing is to make a column of bricks, united by cement, and after they have dried, to extend the column horizontally like an arm, supported at one end only, thus bringing the strain of the weight of the whole mass upon the last joint of cement. Some columns six feet long were shown extended in this way.

Important results are obtained by the employment of "*bétons agglomérés*," which consist of intimate mixtures of sand and lime, with a very small amount of water. The novelty does not consist in the use of new materials, but only in the manner of preparing and using them. It is claimed that by securing the intimate admixture of the materials, and the use of only just sufficient water to moisten the surfaces of the grains of sand, the mixture rapidly hardens into stone, and that the particles are held together with extraordinary force. The use of water in excess, as in ordinary mortar, it is said, leaves innumerable cavities, which render ordinary mortars porous, friable and crumbling. This mixture, when properly prepared, may be moulded into any form, and will, in a few days at farthest, become as hard and firm as natural stone, and quite as capable of resisting the action of the weather. With these properties it is easy to see that monoliths of almost any dimensions may be made, and that the mixture must be of immense value in building.

ASPHALT AND BITUMEN.

But the results with Béton are not so extraordinary as those obtained with a calcareous rock impregnated with bitumen, which is now successfully employed for paving the roadways of the finest streets of Paris. This rock is comparatively rare, being found at only a few localities in the Jura Mountains, where it can be extracted with advantage. It is called *asphalte* by the French, but consists of ninety to ninety-four per cent. of carbonate of lime and ten to six of bitumen, and is a bituminous or asphaltic limestone. It has the appearance of crude gypsum, and has a chocolate color, but becomes white or bleached on exposure to the weather. On close examination it is found that each small grain or particle of the rock is enfilmed with bitumen, coating it like a varnish and causing all the particles to closely adhere. When the rock is heated this bitumen softens, and the mass crumbles to powder, but speedily hardens upon cooling. Upon this property is founded its use for paving and other purposes.

The roadway is first graded and covered with a layer of concrete from four to six inches thick, according to the nature of the ground, the object being to furnish a firm, solid foundation upon which to spread the hot powdered asphalt in a thin, even layer. The asphalt rock is first broken into fragments about as large as those ordinarily used in macadamizing. It is then "decrepitated" by heating it in sheet iron vessels to a gentle heat until it falls into powder. This is generally done near the place where the pavement is to be laid. While still hot it is taken in iron carts to the place and spread in an even layer upon the surface

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* My attention was called to this subject, but I was unable to see any experiments or to devote any time to an investigation of its merits. The above notice is based upon information received, and in part upon the treatise of Francois Coignet, "Emploi des Bétons Agglomérés." 8vo. Paris, 1862. Eugene La Croix, Editeur.

of the concrete, which must be quite clean and smooth. It is only necessary to spread the warm powder evenly, and then to tamp it by means of large flat-faced irons, which are first heated in a portable furnace near by. In this way a perfectly smooth, even surface is given to the asphalt, and in two hours it is as hard as stone, and horses may be driven upon it. It is usually compressed before being used, by passing over it a heavy roller weighing from two thousand five hundred to three thousand kilogrammes. It is then as smooth as any floor and presents a continuous unbroken surface of stone. The thickness of this layer is usually from one and one half to two inches, and it is estimated that the wear is not more than a millimetre per annum, or less than the one thirty-second part of an inch. This seems almost incredible, but it is evident from the nature of the surface that it must wear a long time, for there are no joints or inequalities to jar the wheels of passing vehicles, which roll over it with the greatest ease and almost without noise. It is found, also, that horses do not slip upon this pavement as easily as upon stone. The asphalt can be taken up at any time and be relaid, for it does not lose its property of softening by use. So, also, a new piece of pavement may be perfectly joined to an old layer by simply heating the edges with hot iron.

Among its other advantages, it is impervious to water, and may be used for roofs, or for lining cisterns. It is said that a similar material was used in Memphis and Babylon some thousands of years ago.

Such material would be invaluable in California, and it is highly probable that it occurs in the Coast ranges.

Bitumen is also used to a considerable extent for the sidewalks of Paris, but it is mixed with the asphaltic rock so as to form what is termed *mastic d'asphalte.*

This is prepared by heating from ninety to one hundred kilogrammes of bitumen in an open boiler, and when the mass is quite liquid and at or near the point of volatilization, the asphaltic rock is thrown into it, little by little. This rapidly falls into powder and mixes with the bitumen. The operation is continued until the mass becomes pasty, and then somewhat friable and begins to stick to the sides of the vessel and to the arms of the agitators. Six hours is required for the heating and mixing. It is then run off and cast into molds so as to form circular cakes or discs about one foot in diameter and four inches thick. In this form it is sent to Paris to be used for the pavements and for other purposes. The mixture contains nearly one hundred parts of bitumen and fourteen hundred of asphalt.

The compound is used not only for sidewalks, but for forming tight joints between stones in damp places and to prevent the infiltration of water through the masonry of arches, to line cisterns and reservoirs for water, and as a substitute for brick or tile floors in public buildings. For the sidewalks of Paris it is mixed with gravel in the proportion of twenty-three of mastic to fifteen of gravel. The mastic is melted in a portable sheet iron boiler mounted on two wheels, so that it can be readily moved from place to place by one horse. It is cylindrical in form, and the rear end has a fire-box like that of a locomotive, and the flames and smoke circulate under the boiler and escape at the other end through a sheet iron chimney about six feet high. Their capacity is ordinarily equal to about nine square metres of pavement. A little bitumen is added to aid in the liquefaction or fusion of the mastic, and when it is all melted the clean and dry gravel is thrown in. The pavement is usually made with a layer of concrete from two to four inches

thick, on which the mastic and gravel is spread to a depth or thickness of one half to three fourths of an inch. Each square metre of sidewalk so covered requires:

Material.	Kilogrammes.
Asphaltic mastic	23.0
Gravel	15.0
Bitumen to aid the melting	1.5

And the price, including a bed or layer of concrete four inches thick, is six francs to the square metre. The following table shows the price in Paris of the asphalt, the asphalt mastic, and the principal works in bitumen of Val-de-Travers:*

Asphalt and works in bitumen.	Francs.
Asphalt rock, per metric quintal	7.00
Asphalt in powder, per metric quintal	8.00
Bituminous mastic, in cakes, per metric quintal	11 00
Bitumen, refined, per metric quintal	40.00
Sidewalks, barracks, etc., one half inch thick, per square metre	4.25
Pavements, on a slope, per square metre	6.50
Covering vaults, per square metre	5.50
Roadways in mastic, or pressed asphalt, per square metre	13.00

* For this table and a part of the foregoing data I am indebted to M. J. Claudel, "Pratique de l'Art de Construire."

CHAPTER VII.

MINING MACHINERY.

It is the general expression of mining engineers and experts who visited the Exposition, that the display of mining machinery was not as large and interesting as there was reason to expect. One explanation of the disappointment may be found in the fact that the objects exhibited were scattered about in the vast assemblage of machines in the outer circle, or were placed in the outbuildings of the Park. If all had been brought together in one place, the display would have been considered much more satisfactory. There was, however, very little that was new and striking. There is no great improvement or advance to record—scarcely anything that has not been already described in mining and engineering publications. Some of the most important of late improvements in dressing machinery were not represented at all; such, for example, as the continual working *stossherd* of Rittinger, and his other various contrivances for sizing pulverized ores before concentration. The California pan machines, concentrators, etc., which form the bulk of our mining exhibits at the exhibitions of the Mechanics' Institute, were not to be found in the Exhibition, nor a stamp mill or the parts of one. In fact, there is not one in Europe comparable with ours for perfection of construction or in working effect. The bulk of the exhibit, however, consisted of the very machines in which we on the Pacific Coast are most deficient and behind the rest of the mining world, namely: hoisting machinery.

The various objects exhibited may be classed under the following heads:

First—Mining tools.
Second—Rock perforators or drilling machines.
Third—Boring tools for wells or shafts.
Fourth—Hoisting engines and apparatus.
Fifth—Cables.
Sixth—Cages and wagons.
Seventh—Machines for crushing and dressing ores.

MINING TOOLS.

Under this head are included drills, hammers, picks, blasting implements, lamps, etc. The tools of Germany and Austria were shown in their respective sections, and were displayed upon the walls above the maps and sections of mines. All of the drills are characterized by their extreme lightness, as compared with American tools of the same kind. Round bar iron tipped with steel, or round steel, is used instead of octagonal bars. The picks, however, are more heavy and clumsy than ours, and are not so well mounted. There is no wood so well adapted to the purpose as our hickory, and in no other country is so much pains taken as with us in fashioning the handles of common tools. Some turned pick-handles from Australia, made of the hard woods of that country, may be cited as an exception.

The various mining costumes sent may be appropriately noted here—although a detailed description is impossible. In the Chilean section the heap of copper and silver ores was permanently presided over by a figure of a miner with one foot resting upon a block of the ore. In the Austrian section two figures displayed the peculiarities of the German miner's dress, including, of course, the fanciful cap and the leather apron placed behind. In the Park of the French section a complete miner's cottage gave a view of the home comforts of the French collier, and at the same time served the purpose of exhibition of the great variety of coal mining tools and mining lamps placed around the room.

ROCK DRILLING MACHINES.

There was more of novelty under this head than any other. There were machines for drilling holes, driven either by the force of compressed air or by water under pressure; machines to drill one hole, or to drill several at the same time, or to cut an annular groove or channel around a central core of rock in opening tunnels. To describe all these machines would be to give a long chapter of the experience at the tunnel of Mount Cenis. The machine of General Haupt attracted much attention in France and in England, and was noticed by the General himself at the meeting of the British Association at Dundee. He claims to have achieved a perfect success in the application of steam to tunnelling, and he makes out a very strong case against the advocates of compressed air, by showing what an enormous force is required to force it to great distances in pipes of ordinary diameter. He proposes to mine in true military style by throwing up breastworks in front of a blast, so that the miners need not lose time by retreating at the word "fire," but stand and face the shots like heroes. This may suit military miners, but it will be a long time before we can find any better and cheaper protection than a cross-cut or side drift.

The drilling machine was tested in Cornwall last Summer, but is said not to have given the expected satisfaction to the Cornishmen.

In the Swedish section, the boring machine of Bergstroem was at work upon a mass of hard iron ore. It is said to be in successful use at the Perseberg iron mines of Sweden, and to have replaced hand labor in drilling, with a saving of twenty to twenty-five per cent. in cost. This machine is worked by compressed air, weighs only one hundred and twenty-two pounds, and costs about one hundred dollars. It is small and compact, and is supported in place by set-screws bearing against the top and the bottom, or against the sides of the tunnel.

The Swedish machine is the most portable and compact which has been shown, but we are promised something still better by Darlington, of England, who will use the pressure of a column of water to operate the drill. His machine will be shortly introduced to the notice of California miners, and it has this great recommendation for them, that it is very light and cheap, and is to be operated by water alone, and does not require any engine or expense for installation.

In the French section, Messrs. Huet & Gayler showed a perforator, the invention of M. de la Roche Tolay and M. Pirret, which operates upon the hardest rocks by means of rough diamonds set firmly in the end of a long, hollow cylinder, about as large as a gun barrel. The cylinder thus armed is made to revolve rapidly and is brought against the rock by the pressure of water. The diamonds at the end form a kind of "crown saw," and they cut the rock, whether limestone, sandstone, granite or flint, into powder. This powder is removed by a constant stream of water, which at the same time keeps the drill cool. An annular channel or opening is thus made in the rock, and the central core of rock passes into the hollow of the drill, and breaks out when the drill is withdrawn. The diamonds last a long time before they show wear, and when they lose their cutting angles they are turned over in their setting. The tip of the drill in which they are set is attached to the cylinder by a bayonet joint, and can thus be changed with facility.

This is also known as the "Leschot drill," and the same or a similar drill has been used to drill holes at least four inches in diameter in the oil regions of Pennsylvania.

It is claimed that with this drill and the apparatus which has been noticed, holes may be drilled in quartz at the rate of over half an inch per minute under a pressure of eight hemispheres and one hundred turns per minute. In mica slates the advance is about an inch and a half. With the same pressure and a velocity of two hundred and fifty turns per minute, the progress in quartz is increased to one and one-third inches per minute.

COAL CUTTING MACHINE.

A machine is shown in the English section for under-cutting coal beds or blocking out masses of coal. It is operated by compressed air, and will cut a channel only two or three inches wide and two feet or more in depth. It is said to be in successful operation in England and to effect a great saving over hand labor, not only in work but in coal also, as there is not so much waste.

Another machine, shown by Messrs. Carrett, Marshall & Co., of Leeds, is so contrived as to plane or gouge out a groove in the coal by means of strong steel cutters, mounted one behind the other on a strong bar of steel, to which a reciprocating motion is given The tool is forced against the coal by hydraulic pressure, and there is no percussion and but little noise.

The colliers of South Lancashire and Cheshire have offered prizes of five hundred, two hundred and one hundred pounds sterling for the first, second and third best coal cutting machines.

TOOLS FOR BORING SHAFTS.

It is unnecessary to describe the various forms of augers and drills for boring artesian wells displayed in the French section. They are not superior to those now in use with us for sinking oil wells. But there is

another class of boring tools used for opening shafts in soft ground or in stratified formations that can be easily perforated and where quantities of water are encountered.

These tools are enormous reamers or drills from ten to sixteen feet across the face, so that they will open circular shafts of the same dimensions. They are made of wrought iron and weigh many tons. A massive cross-head is armed with stout steel cutters like teeth, set in rows at the outer ends and projecting downwards. A small guide hole being first bored into the earth, these larger tools are made to follow and enlarge it. At the same time the shaft is lined by a water-tight curbing or cylinder of wrought-iron, made in short sections one bolted upon another by means of flanges, which are suspended and descend as the shaft progresses. The lower section is made double, and the space is so filled in with moss or tow that when the boring is completed and the weight of the iron curb or lining is allowed to rest upon the moss it is pressed outwards against the sides of the shaft, and thus, by making a tight joint, excludes the water from the shaft. It will be observed that the whole of the lining, including the double portion and packing at the bottom, is kept suspended as the boring progresses, and is not allowed to rest upon the bottom until the desired stratum is reached and a firm foundation is cut in it by the boring tool. During the whole operation the shaft is full of water, and it is not pumped out until the lining is finally secured in the shaft.

Two pits have been sunk in this way at St. Arold, through very watery ground, and with a very great saving of time and expense. In one of the pits the curb was fixed at a depth of five hundred and twenty-three feet, and the coal was reached at a depth of one thousand and thirty-six feet. It is probable that this ingenious method of sinking shafts may be adopted with advantage in the lower portions of the Mount Diablo coal field, where the strata are full of water and are not too hard to be easily bored. The credit of the invention and perfection of this method is due to Messrs. Kind & Chudron, and they received a grand prize.

MACHINES FOR EXTRACTION.

Hoisting engines and apparatus were found only in the French and Belgian sections. In the former, the most conspicuous was a machine with double vertical engines, and the winding reels or bobbins high in the air above them. This was from the establishment of Quillac, at Anzin, which has turned out a large number of powerful engines of similar construction for the French coal mines. They claim to have supplied sixty-seven machines, of the aggregate horse-power of seven thousand and twelve, since eighteen hundred and fifty-six. One of five hundred horse power was for pumping. The cylinders of the engine in the Exhibition were about three feet diameter and six feet stroke. They were connected directly with the bobbin shaft above, without gearing. This shaft carried two bobbins, twenty-two feet in diameter, intended for flat wire or hemp cables. The wooden arms of these bobbins are united at their extremities by segments of iron. The engineer stands on an elevated platform and looks under and between the bobbins towards the mouth of the shaft. The movement is controlled by link motion, and the brakes are operated by steam. The poppet heads, pulleys and frame work, to be placed over the mouth of the shaft, together with the cages, guides and wagons, were shown in connection with the engines, and the whole formed the most complete and attractive looking hoisting appa-

ratus exhibited; but it is questionable if this vertical arrangement is so desirable as the horizontal. Another hoisting apparatus in the Belgian section had the bobbins placed below the cylinders, the shaft being on the level of the floor, and the cylinders inverted above it. The engineer of the machine stands above the whole, and has an unobstructed view of the shaft and the pulleys above it.

There were also two or three beautifully finished horizontal hoisting engines, all of them double and direct acting upon the bobbin shaft. Some of the bobbins were provided with light wrought iron segments to connect the spokes. Most of the machines had friction bands suspended around a central or outer wheel, made specially for the purpose. These bands were operated by steam. Other machines had brakes instead of metal bands. These were merely segments of wood set in iron frames and drawn forcibly against the opposite sides of a friction wheel, on the main shaft, by means of levers also operated by steam. The power varies from eighty to one hundred and fifty horses.

These machines all had a very light, airy appearance, and were somewhat in contrast with another machine shown in the Park, in the building devoted to the productions of the great establishment of Creuzot. This was made for the coal mines of Blanzy, to perform very heavy work, and is very strong and solid. It is horizontal, double engines and direct-acting. The cylinders are very long, and are placed some twenty feet apart. The bobbins are for flat cable and are twenty feet in diameter; the spokes are not connected by metal rims, but are left disconnected at the outer ends. There is a separate steam cylinder for working the breaks. It is a notable fact that winding and pumping engines have been made by Quillac, at Anzin, France, for English coal mines in Newcastle, and the explanation is, simply, that the French are able to furnish satisfactory and highly finished engines at lower prices than English establishments require.

CABLES.

Some very heavy and well made flat wire cables were shown in the French and Belgian sections. In the Belgian, some were made of ordinary round wire cables, one inch in diameter, and united side by side, and were long enough for mines two thousand eight hundred feet deep. It is claimed that this is an improvement over the usual mode of laying the flat cables, and that it permits more rapid winding. I did not see, however, any better samples of light wire rope work than those shown in the United States section by A. S. Hallidie & Co., of San Francisco.

CAGES AND WAGONS.

The system of using cages of several stories, so as to take wagons one above another, is being abandoned, as much as possible, for the broad cage, to receive the wagons upon the same level. This, of course, necessitates a larger shaft, but the saving of time, trouble and wear is very great over the other method.

Nicholas Libotte, of Belgium, exhibited some very well made cages, made wholly of steel, intended for the mines of a coal company near Liege, Belgium. They are made to take two tiers of wagons, three on each, or six wagons in all. The cage weighs one thousand two hundred and sixty-eight kilogrammes (about two thousand five hundred and thirty-six pounds), and the parachute attachment three hundred and twenty-

eight pounds. Another cage is constructed to take six wagons, one above another—total weight, including parachute, three thousand one hundred and twenty-four pounds. The wagons intended for this cage are about six feet long and two feet six inches wide. The guides in the shafts are intended to be made of wood, and the slides or bearings on the cage are made of steel. All the cages shown were provided with safety parachutes, not differing particularly from those already often described. The great advantage of these steel cages is their lightness, compared with those made of iron of equal strength.

CRUSHING AND DRESSING MACHINES.

The only ore crushers shown were Blake's rock breaker, and the well known Cornish rollers; the former, being exhibited by the assignees of the patent in France, was in the French section, and received a gold medal. The same parties showed self-acting and discharging jigs, modifications of the Cornish machine, with the grates fixed and the water forced up through them and the ore by a plunger. These are made entirely of cast iron, and were operating very well upon lead ore. A table for dressing fine ore was made of an endless belt of canvas, which moves in a direction opposite to the flow of the ore, and at the same time receives a shock or percussion. With the exception of the percussion, the arrangement is very similar to one tried by Mr. Williams, at the Benton mill, some years ago, and abandoned as unsatisfactory.

CHAPTER VIII.

WINES AND FERMENTED DRINKS, ALCOHOL, BEET ROOT SUGAR, VINEGAR, MUSTARD AND CHICCORY.

WINES OF THE UNITED STATES.

The display of wines and fermented liquors of all kinds, from various parts of the world, was enormous, as will appear from the following enumeration:

Countries.	Exhibitors.
France	600
Spain	316
Portugal	121
Algeria	142
Prussia	119
Switzerland	82
Italy	479
Brazil	85
South Australia and Victoria	32
The United States	33

With this vast amount of work before the Jury, it is not surprising that the wines of the United States, including those of California, did not receive more attention. In the United States exhibit, besides the Californian wines, there were samples of the sparkling and still Catawba wines and brandies from Cincinnati, Ohio; red and white wines from Pennsylvania, sparkling Catawba from grapes grown in the State of New York, and other wines from Ohio, Indiana and Missouri. Honorable mention was made of the sparkling wine sent by the Buena Vista Vinicultural Society of Sonoma, R. N. Van Brunt, Secretary, San Fran-

cisco, which appeared to have been much liked, as two cases of it were nearly consumed in the trials by the experts.

In order to remedy the disappointment of the United States wine exhibitors, the United States Commission appointed a Committee to specially examine American wines and make a report. This Committee consisted of Mr. Flagg of New York, Marshall P. Wilder of Boston, and Dr. Jacob Thompson. The American wines were placed in their charge, and were tasted from time to time. The report of this Committee will be made to Congress, with the other reports of the Commission, and will probably be printed at some distant day.

Complaint has been made about the placing of these wines—that they were heated and fermented, etc. This is probably a mistake, for in July and August there were no signs of fermentation. It is true that the wines were not put into the coolest possible place, but the flues spoken of by some were several feet distant, and would hardly be noticed by most persons. The bottles were placed cork up, except the champagnes, as was the case with the other exhibits throughout the Exhibition.

This habit of heating the wine recalls the discovery made by the French chemist, Pasteur, of the existence of invisible vegetable growths in wines, which cause fermentation or disease, destructive of the good qualities. This discovery was made by the aid of the microscope, and is another example of the practical value of the instrument. M. Pasteur has also shown that the germs of this vegetable growth can be destroyed by simply heating the wine in closed vessels to a temperature of sixty degrees centigrade, for only a few minutes. Numberless experiments have confirmed the discovery, and have proved at the same time that the operation does not injure the flavor of the wine, but, on the contrary, very often improves it. I had the pleasure of tasting some of the wines which M. Pasteur had treated, and found the difference very marked in favor of the wine that had been heated, except in one instance. These wines were brought by M. Pasteur to a chemical entertainment at the laboratory of the illustrious St. Claire Deville.

The researches of Pasteur have been published in a beautiful volume, by Victor Masson, and are entitled "Etudes sur le Vin."

The same chemist is now busily engaged in investigating the disease of the silkworm, by the aid of the microscope. He finds that the germs of the disease may be detected in the eggs. Diseased eggs may therefore be thrown away. His method consists merely in grinding up samples of the eggs in a mortar, and placing a little of the paste under the lens. The same method has been extended to the testing of the bodies of the millers that lay the eggs.

WINE AND FERMENTED DRINKS IN FRANCE.

The following valuable data upon the product and consumption of wines and alcohol in France are extracted from the Introduction to Class Seventy-three, in the Official Catalogue:*

"Viticultural production is one of the most important in French agriculture. It extends over two millions two hundred and eighty-seven

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* This Introduction was prepared by Comte Herve de Kergolay, President, and Louis Baral, Delegate, of Class 73.

thousand eight hundred and twenty-one hectares,* situated in eighty-one departments, the yield being on an average fifty million hectolitres, of a total value to the producers of seven hundred and fifty million francs. In eighteen hundred and sixty-five the quantity reached sixty-eight millions nine hundred and forty-two thousand nine hundred and thirty-one hectolitres; and, considering the development that has taken place during the last few years, it is certain that unless checked by the grape disease (the oïdium) the amount of fifty million hectolitres will generally be exceeded. Vineyard property is excessively subdivided. It is held by no less than two millions two hundred thousand proprietors, so that each property on an average scarcely exceeds one hectare. The cost of cultivation varies considerably, according to the season and the rate of wages in the various districts of France. They range from one hundred and fifty francs to five hundred and seventy francs per hectare, which gives for the rate of wages from one franc and ninety centimes to four francs and even five francs per day. The trade in wine is of course a very considerable one. The City of Paris alone consumes annually about three millions six hundred thousand hectares; that is to say, an average of one hundred and eighty-three litres (a litre is rather more than one and three fourths pints) per head for each inhabitant, and this consumption would certainly go on increasing largely if it were not impeded by the present system of taxes, and by their heavy rates. The city, or *octroi*, duties, for instance, exceed in amount the value of the greater part of the wine on which they are placed. Exportation increases every year, under the influence of the new treaty of commerce. In the year eighteen hundred and sixty-six the exports amounted to three millions one hundred and ninety-four thousand one hundred and four hectolitres, of the value of three hundred and eight millions five hundred and two thousand francs, while in eighteen hundred and fifty-one the total value did not exceed one hundred and ninety-five millions nine hundred and twenty-three thousand francs. Thus in five years there has been an increase to the extent of sixty per cent. The value of the exports of spirits and liquors amounted in eighteen hundred and sixty-six to ninety-three millions nine hundred and seventy thousand francs, while in eighteen hundred and sixty-one it had not reached over fifty-two millions nine hundred and sixty-six thousand francs. It had, therefore, increased to the extent of eighty per cent. in the same period. The total amount of the exports of wine and spirits in eighteen hundred and sixty-six was, then, four hundred and two millions four hundred and seventy-two thousand francs. In eighteen hundred and sixty-six the prices were far below those of eighteen hundred and sixty-five. This reduction of price, combined with the changes introduced into the English tariff, which made the duty on wine introduced in bottle the same as that imported in the wood, has increased the exports of wine from France to England from ninety-four thousand three hundred and eighty-five hectolitres to two hundred and five thousand nine hundred and ninety-two hectolitres; that is to say, an augmentation of one hundred and twenty per cent. between eighteen hundred and sixty-five and eighteen hundred and sixty-six; and it is hoped that this consumption will overcome the obstacles which arise out of the organization of trade in England and the great number of local taxes.

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* A *hectare*—nearly two and a half acres; a *hectolitre*—twenty-two and a half gallons.

"Sixty-five Departments have taken part in the Exhibition of eighteen hundred and sixty-seven; they are represented by six hundred exhibitors. Unfortunately, the exhibition of the great growths of the Bordelais is far from being complete As to Burgundy, the Chamber of Commerce and the Agricultural Societies and Committees have zealously competed in the organization of a most remarkable exhibition. Two thousand four hundred bottles of wines were sent from Burgundy, as follows:

Districts.	Bottles.
From Villefranche	600
From Macon and La Chapelle de Guinchay	400
From Chalon	200
From Beaune	400
From Dijon	200
From Avallon	50
From Auxerre	400
From Yonnerre	400
From Joigny	50

"Various processes have been proposed and experimented on recently with the view to the improvement and management of the fermentation of wine, and particularly to make it capable of bearing changes of temperature and more especially long sea voyages; but the most important improvement to be noticed is certainly that of an illustrious chemist, M. Pasteur. [Already noticed]

"The production of alcohol in France has averaged, during the last ten years, one million one hundred and twenty-four thousand eight hundred and seventy-two hectolitres; but the increase has latterly been very considerable. Thus the season of eighteen hundred and sixty-three and eighteen hundred and sixty-four produced one million two hundred and seventy-eight thousand one hundred and ninety-two hectolitres; eighteen hundred and sixty-four and eighteen hundred and sixty-five, one million three hundred and five thousand nine hundred and five; eighteen hundred and sixty-five and eighteen hundred and sixty-six, one million seven hundred and eighty-nine thousand four hundred and seventy-four, which is divided as follows:

Distilled.	Hectolitres.
Distillation of wine, 12,000,000 hectolitres, giving in alcohol.	1,010,166
Beet root	283,022
Molasses	307,409
Farinaceous substances	79,648
Lees and fruits	53,232
Various substances	55,997
Total	1,789,474

"The average annual production of cider during the past ten years has been nine million fifty-seven thousand five hundred and seventy hectolitres; in eighteen hundred and sixty-six it was eleven million three hundred and twenty-three thousand seven hundred and forty-five hectolitres, and it increases every year. The railways contribute largely to this result by transporting rapidly the cider apples from the place of production to the centres of consumption. The consequence is that the price of apples has been augmented, and that the farmers find it worth their while to extend their plantations. The consumption of cider is also larger than it was, because in many districts where nothing but water was drunk, they now make use of cider or beer. The best cider in France is made in the neighborhood of Calvados and La Manche, but it is desirable that the proprietors should bestow the same amount of care upon the cultivation and manufacture as the wine growers.

"We have previously said that the consumption of beer increases considerably in several parts of France, where its use was very restricted a few years since. In other localities its use extends even where wine or cider is the common drink of the country. The manufacture has made great progress, and we no longer go to Germany or England for light, agreeable or wholesome beer.

"This development of the brewing trade has produced a similar progress in the cultivation of hops in the Northern and Eastern Departments, and the Vosges and Alsace. At the present time French hops are in as great demand as the best Bavarian hops, and they might pass for them in commerce."

BEET ROOT SUGAR.

Beet root sugar in France is made chiefly in the Northern Departments The product is about two hundred million of kilogrammes, and about the same quantity is imported from the French and foreign colonies. The consumption is about two hundred and fifty million kilogrammes and the difference is exported. The manufacture and refining of beet root sugar has made great progress since eighteen hundred and fifty-seven, and it has consequently been produced at a lower price. The customs duty upon beet sugar is forty-two francs per one hundred kilogrammes.

The principal improvements in the manufacture of sugar are: The process of double carbonization, triple action vacuum pans, the use of centrifugal machines; and in refining, the improvements in the system of bleaching, and the employment of centrifugal machines.

Within the last five years beet root sugar of superior quality, made by the aid of the improved apparatus of Cail & Co., has been used in the manufacture of confectionery. Sugar of this kind is worth about one hundred and seventeen francs per one hundred kilogrammes.

A great variety of sugar making apparatus was exhibited—such as machines for removing stones, rasping machines, mills, presses, tissues for sacks, filtering presses, apparatus for evaporating the juice in vacuo, either single, double or triple. There was also a variety of centrifugal machines and furnaces for reheating the animal charcoal used to decolorize the solutions. One of the rasping machines shown by M. Champonnois makes seven hundred revolutions a minute and rasps over thirteen thousand pounds of beets in an hour.

The stimulus given to the production of beet roots in Prussia and elsewhere by the large and cheap production of potash salts suitable for

manure, at Stassfurt, has already been noticed in the chapter upon useful minerals.

A novel practical application of endosmose to the concentration of saccharine liquids has been made by Dubrunfaut, and Messrs. Carmichel & Co., refiners of sugar and distillers, at St. Clair de la Tour-du-pin, exhibited an apparatus for the purpose, which is stated to have been in successful operation at their establishment for three years. It was not accompanied by a description, but its mode of action was quite plain to those familiar, by experiment in the laboratory, with the laws of endosmose and exosmose. The apparatus appears like a great cubical box about four feet square, but it is made up of a series of sheets of vegetable parchment stretched upon frames and placed side by side, so that they are not more than one inch apart. By passing through these membranes the solutions are gradually concentrated. This is called the Osmogene process.

VINEGAR, MUSTARD, CHICCORY.

The best vinegar in France is made from the white wines of the Loire and of the Charente. The preparation consists in fermenting these wines by heat applied by steam or otherwise under reservoirs constructed for the process. Machinery is used to transfer the liquid from one vessel to another. The researches of Pasteur have thrown light upon many points which were before obscure. The annual production is about one million five hundred thousand hectolitres, worth, at twenty francs, about thirty million francs or six million dollars. The price varies with the season, from five francs to twenty francs per hectolitre.

The annual product of mustard in France is about six hundred and fifty tons, worth one hundred and fifty thousand francs. Mixed with condiments and vinegar, and ground in mills, it is made ready for the table, and the annual value of the production is estimated at two million francs. It is cultivated chiefly in the Northern Departments.

The preparation and use of chicoory as a substitute for coffee was a result of the continental blockade, but its use has continued and is increasing. It is cultivated in the northern part of France, and in the Haut and Bas Rhin.

The green roots are worth from four and a half to five francs the one hundred kilogrammes. They are roasted and dried in large establishments, and are reduced to powder. The sliced and dried roots are worth from eighteen to twenty-four francs. The prepared powder is worth from forty to fifty francs the one hundred kilogrammes. The annual product is estimated to be seven thousand tons and to be worth from three million five hundred thousand to four million francs.

LIST OF EXHIBITORS

OF OBJECTS FROM CALIFORNIA AT THE PARIS EXPOSITION.

Names and Articles Exhibited.	Group.	Class.
MISSION WOOLLEN MILLS, San Francisco, Lazard Fréres, Agents. Four cases of woollen goods, manufactured in California from California wool.....	IV	30
C. H. HARRISON, San Francisco. Centrifugal pump.....	.....	.....
C. E. WATKINS, San Francisco. Series of twenty-eight large photographic views of Yosemite Valley, and two of the Big Trees of the Mariposa Grove.....	II	9
LAWRENCE & HOUSEWORTH, San Francisco. Twenty-six large photographs of Yosemite Valley and of the Great Trees, and three hundred stereoscopic views of different localities in California.....	II	9
EDWARD VISCHER, San Francisco. One case containing six portfolios of views in California and Washoe...	II	9
A. S. HALLIDIE & Co., San Francisco. Samples of wire rope, round and flat, and iron and copper sash cords of California manufacture.....	V	40
PACIFIC GLASS WORKS, San Francisco. Specimens of California made glass bottles.....	III	16
JOHN D. BOYD, San Francisco. One highly finished ornamental door, made of wood grown in California.....	III	14
JOHN D. BOYD, San Francisco Specimens of the wood of the Madrona, or California laurel.....	V	41
JOHN REED, San Francisco. Premium tank lifeboat model, four feet long.....	VI	66
SAN LORENZO PAPER MILLS. Varieties of paper made at the company's mills in Santa Cruz, California.....	.....	.....
STANDARD SOAP COMPANY. Specimens of California made soap and washing powders.....	.....	.....

Names and Articles Exhibited.	Group.	Class.
D. L. Perkins, San Francisco and Oakland. Collection of seeds grown in California, and a photograph of California vegetables. (Donated to the Imperial Garden of Acclimatation.)	VII	67
J. W. H. Campbell, San Francisco. One case—about one hundred and twenty pounds—California high mixed wheat. (Donated to Royal Agricultural Society, England)	VII	67
J. D. Peters, San Joaquin County. One box containing about thirty pounds of wheat	VII	67
Buena Vista Vinicultural Society (by R. N. Van Brunt, Secretary). Cases of sparkling wine made from grapes grown at the Society's vineyard, Sonoma County, California, eighteen hundred and sixty-five	VII	73
C. H. Le Franc, New Almaden Vineyard. Four cases of red and white wines made in San José, California	VII	73
Sansevain Brothers, Los Angeles. One case of California wine	VII	73
Kohler & Frohling. California wines	VII	73
M. Keller, Los Angeles. Four cases of California wines.	VII	73
A. Fenkhausen, San Francisco. Three cases California wine and bitters	VII	73
Taylor & Bendel, San Francisco. One case of stomach bitters	VII	73
Dr. J. Pigné, San Francisco. Six cases of California and Nevada minerals and ores. (Donated to the School of Mines, Paris)	V	40
California State Agricultural Society. Volumes of the Society's reports for distribution	V	40
William P. Blake, San Francisco. Collection of California minerals and ores. (See list of minerals and ores.)	V	40
Drs. Harkness and Frey, Sacramento. Large mass of silver ore from Blind Springs, Mono County, California, weighing about one hundred pounds	V	40

LIST OF MINERALS AND ORES

SENT TO THE PARIS EXHIBITION FROM CALIFORNIA BY THE STATE COMMISSIONER.

NOTE.—The names of donors of specimens for the collection are given after the names of the specimens. When not otherwise stated, the specimens were from the private collection of the Commissioner, or were collected by him for the Exhibition.

Exhibit.	No.
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Bituminous coal, Independence and Eureka mine (710 feet deep) Mt. Diablo, California. Greenhood & Newbaur	2
Brown coal, Cowlitz River, Oregon	3
Bituminous shale, Isthmus of Nicaragua, New Granada	4
Native sulphur, Tehama County, California. R. G. Sneath	5
Native sulphur, Colusa County, California	6
Sulphur, manufactured, Colusa County, California	7
Native sulphur, Cañada Larga, Santa Barbara County, California	8
Rock salt, native, in large crystals, Virgin River, Arizona. Winegar & Shaw	9
Rock salt, manufactured, Los Angeles County, California. Winegar & Shaw	10
Rock salt, ground in water, Los Angeles County, California. Winegar & Shaw	11
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The specimens were all carefully numbered as above, and accompanied by labels, giving the locality in full. They were all fresh and characteristic specimens, and were, generally, about four inches square. The only box of specimens sent in for the collection was from Messrs. Crossman & Cochrane, of Downieville, through whom the mines of that vicinity were well represented. The Agricultural Society, at Sacramento, contributed some fine specimens from the duplicates in its cabinet. Dr. Harkness and Dr. Frey, of Sacramento, sent a large mass of silver ore, weighing over one hundred pounds, from the Camanche claim, Blind Springs (No. 62). This was the largest specimen sent forward, and was separately packed. The whole collection filled eleven boxes.